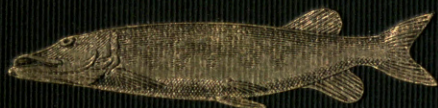


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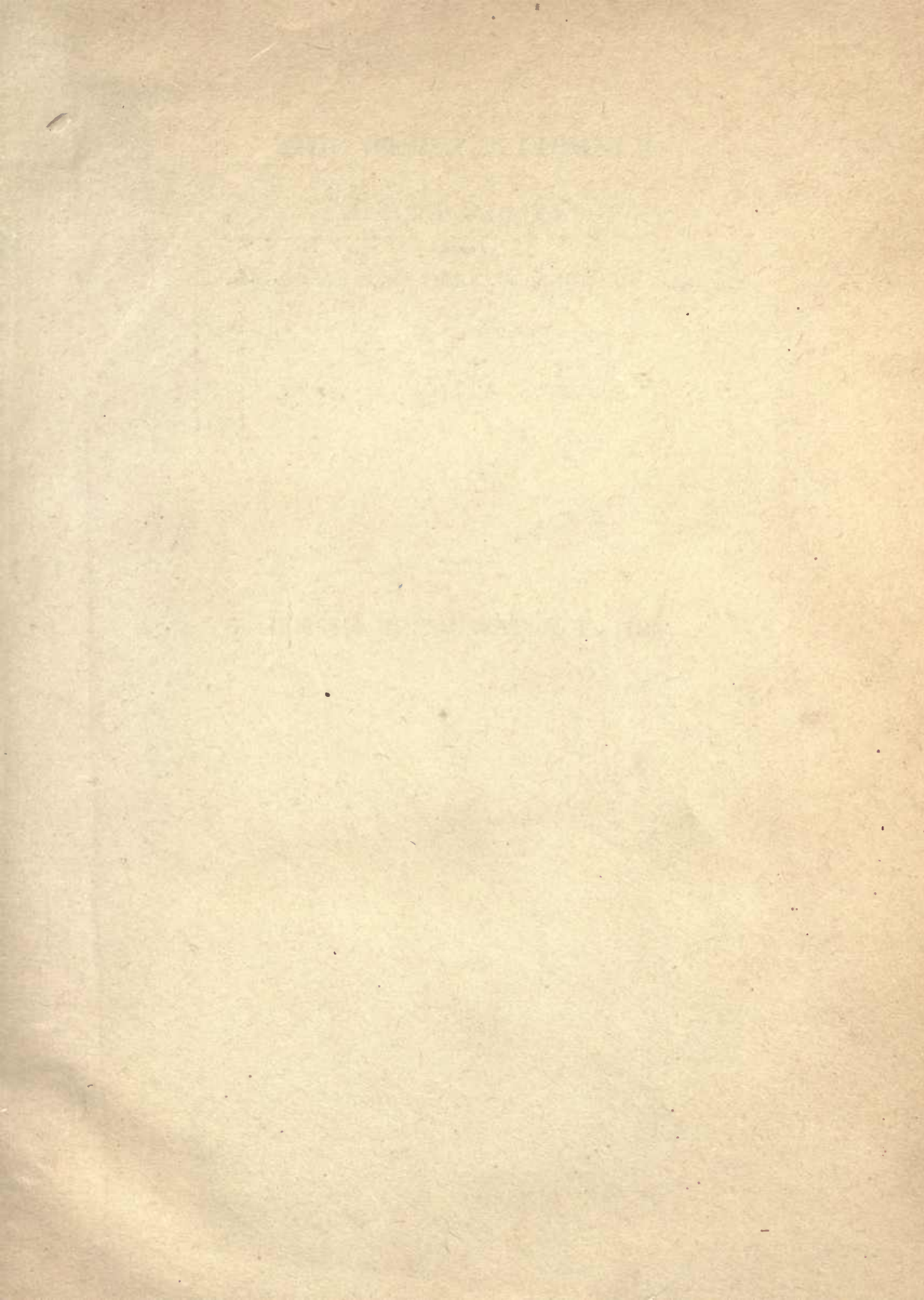
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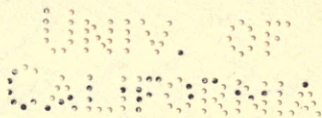
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SIR HERBERT MAXWELL, BART., F.R.S.

AUTHOR OF "SALMON AND SEA TROUT," ETC

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It is not every one who has the taste, capacity, or leisure for the scientific study of Natural History. But there are few persons who do not feel that some knowledge of the processes and products of Nature increases the enjoyment of country life. To supply this knowledge in a form at once easily assimilated and scientifically accurate is the object of the WOBURN SERIES OF NATURAL HISTORY.

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Bedford

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British Fresh-Water Fishes

INTRODUCTION

THERE are few features of human history more startling and unaccountable than that intellectual frost which arrested the growth of natural science at a point of precocious and prosperous development. In the fourth century before Christ, Aristotle laid the foundations of a sound system of zoology, based on original research and observation ; a system which only required correction and expansion by the co-operative labours of succeeding generations of students to embrace all living creatures in their right relation to each other. In regard to aquatic animals, especially, Aristotle had a very keen discernment, surprising in a student who, so far as is known to us, enjoyed no mechanical aid to vision. He neither confused cetacean mammals—whales, dolphins, and the like—with fishes, nor eels with serpents, but defined *branchiæ* and fins as the distinctive organs of true fishes. Aristotle erred in some directions, indeed, and came far short of full knowledge in others, as every student is liable to err and bound to come short ; but we are filled with wonder, not at his limitations, but at the scope of his knowledge and the general rectitude of his conclusions.

Yet when Aristotle died, natural science stood still. Men, indeed, acknowledged his work as a revelation ; but instead of passing the torch from hand to hand, they suffered it to burn

to the socket ; instead of following up the rich vein that he had laid bare, they contented themselves with contemplation of the precious metal he had extracted, and allowed the mine to fill up with all kinds of rubbish. His admirers, far from verifying and extending his observations, treated his conclusions as dogma, which, in accordance with the invariable tendency of the human mind, became a nucleus for all that was false, provided it was marvellous.

Thus it came to pass that for eighteen hundred years the science of ichthyology remained, not in the sound position in which it was left by Aristotle, but encrusted with accumulated error and falsehood. When the revival of learning reached this department of science, its pioneers encountered a vast and disheartening labour in clearing away these layers of ignorance. Belon, Salviani, and Rondelet, working independently of each other, published works on fishes in the sixteenth century, and, among them, cleared the ground for the foundation of a system of classification, whereon the Englishmen, Ray and Willughby, commenced to build in the seventeenth century ; then followed Peter Artedi, the fellow-student of Linnæus, who practically completed the edifice of orders, genera, and species in which ichthyologists conduct their study at this day. Alterations have been made since then by many distinguished men of science ; but these have been but modifications and extensions of the original plan. Arbitrary statement, *a priori* assumption, and venerable fable have been consigned for ever to the rubbish-heap ; henceforth the only furniture admitted to the edifice is sound fact and rational induction.

I have thought it expedient to make these observations before explaining the object of the present work. Of the vast variety of fishes now accurately known to science, only six-and-twenty genera and less than twice that number of species can be reckoned as inhabiting British fresh waters. In describing these, it may seem to some that the general reader might have been spared the unpopular terminology of scientific

classification. It is commonly supposed, at least I have very often heard it suggested, that naturalists delight in Latin names, and employ them unnecessarily in order to display their own erudition. "Everybody knows what you mean by a perch," say some: "why in the world do you want to call it *Perca fluviatilis*?" The answer comes from afar—from the days of Aristotle. The chief obscurity in the luminous discourse upon fishes by that penetrating intellect arises from his use of temporary and local popular names for the different species. It is because such names not only vary from age to age, but are applied simultaneously to different creatures in different localities, that we have been driven by necessity to the dead languages—the languages that have passed beyond all change—to secure precise definition.

Here is an instance of the confusion inevitable in the absence of a scientific standard. Most people know a flounder well enough—at all events, they think they do. But on the south-west coast of Scotland, where flat-fish greatly abound, the true flounder is known as the fluke, and the term flounder is applied popularly to quite a different fish, the plaice. Hence, to avoid confusion, which is the very first step in the advancement of knowledge, it has been necessary to give each of these fish a generic and specific name in an unchangeable language.

Take an instance from the kindred science of ornithology. Among all bird-names there is none, probably, which conveys to British people such a clear, familiar image as that of robin. Even town-bred children, for whom the greenwood, alas! is too often but an unmeaning phrase, have learnt enough from picture books to attach the title to a little red-breasted bird which spends Christmas with us. But see how different is the idea conveyed by the name of robin to that vast branch of the English-speaking race beyond the Atlantic. The early settler in North America chose to apply this name to a kind of thrush (*Merula migratoria*). And, were there no common language wherein ornithologists could confer, science, instead

of being world-wide, must of necessity become national—provincial—parochial—in its scope, as in the days succeeding Aristotle.

Further: no satisfactory understanding of the fauna, or any class in the fauna, of any country can be had unless it is viewed in relation to that of the rest of the world. This is of special importance in dealing with fresh-water fishes, because, severely circumscribed by the limits of the medium in which they exist, the question constantly arises, How did such-and-such a species get into certain rivers and not into others? For example, the significance of the presence of the burbot in rivers running eastward in England, its absence from those running westward, cannot be appreciated unless the affinities of that fish are understood. When it is explained that the burbot is the only member of the great Cod Family known to inhabit fresh water, that it abounds in the rivers of Central and Northern Europe, as well as those of North America, a good deal of light is thrown upon the former connection of the streams of Eastern England with the great watershed of the Rhine. Here, again, is the need for scientific as well as for popular names. The burbot is a cod, but the great Murray cod of Southern Australia is not a cod at all, but a perch.

I hope enough has been said to show that it is from no delight in polysyllables that I have given the scientific names in a work that lays no claim to contribute to the advance of science. The utmost that I have attempted is to describe the appearance, habits, and distribution of the various species, partly from my own observation and, in a far greater degree, from the records of trustworthy observers; and at the same time to give an accurate impression of the position of each genus in the great class of Fishes. In order to do so I have followed generally the classification of Dr. A. Günther, departing from it only in the case of the *Salmonidæ*, wherein close observation has inclined me to believe that too much

respect for local varieties has caused that veteran ichthyologist unduly to multiply species. But I have kept the purely scientific part of the history as subordinate as possible, retaining the classification merely as a clue, avoiding anatomical details, which I am wholly unable to give from original research, and merely indicating the number of fin-rays in each fish, and the arrangement of the teeth, as a simple aid to identification.

Regarding the illustrations, I desire to acknowledge with gratitude the help I have received from those, too numerous to mention by name, who have kindly sent photographs for reproduction. One great difficulty has had to be encountered by Miss Seth, the artist who has prepared coloured reproductions of these photographs—namely, the rapid changes which take place in nearly all fish immediately after death. For instance, in almost every coloured representation that I have ever seen, the iris is coloured red or orange. Now the iris of a living or freshly killed salmon is the palest yellow, dusted with black ; it is only when decomposition has begun that the eye becomes shot with blood ; and the portrait of a salmon can seldom be taken until that process has set in. The delicate skin tints of trout, minnows, sticklebacks, and many other fish are equally evanescent, and tax to the utmost the artist's ingenuity and rapidity of execution.

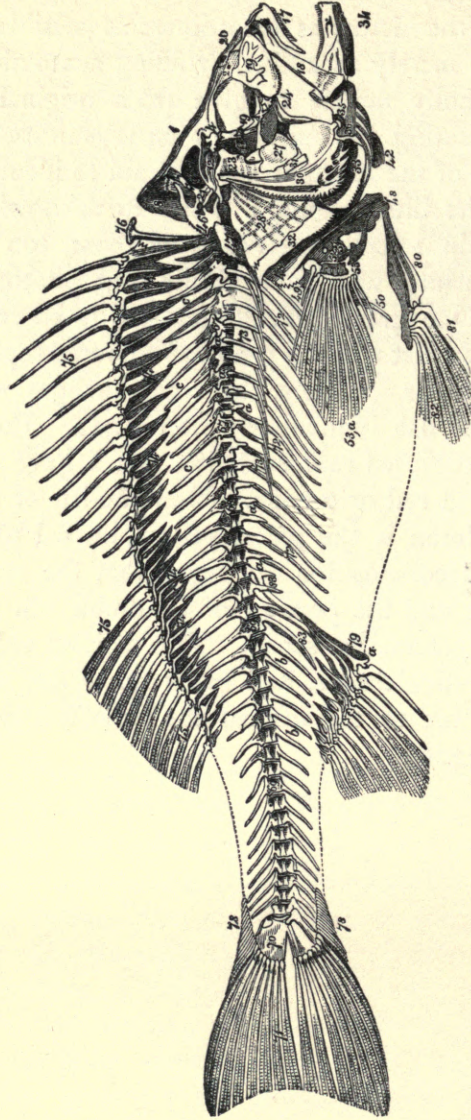


FIG. I.
SKELETON OF THE PERCH.
(After Günther.)

KEY TO SKELETON OF THE PERCH

- | | |
|-------------------------------------|---|
| 1. Frontal bone. | 39. } Basihyal bones. |
| 2. Pre-frontal bone. | 40. } |
| 3. Ethmoid bone. | 41. Glossohyal bone. |
| 4. Post-frontal bone. | 42. Urohyal bone. |
| 5. Basi-occipital bone. | 43. Branchiostegal rays. |
| 6. Basi-sphenoid bone. | 46. Post-temporal bone. |
| 7. Parietal bone. | 47. Supraclavicula. |
| 8. Supra-occipital bone. | 48. Clavicula. |
| 9. Paroccipital bone. | 49. } Post-clavicula. |
| 10. Exoccipital bone. | 50. } |
| 11. Alisphenoid bone. | 51. Coracoid (radius) bone. |
| 12. Mastoid bone. | 52. Scapula (ulna). |
| 13. Squamosal bone. | 53. Carpals and metacarpals. |
| 14. Orbitosphenoid bone. | 53'. } |
| 15. Basisphenoid bone. | 54. } Basibranchials. |
| 16. Vomer. | 55. } |
| 17. Inter- or Pre-maxillary bone. | 58. Ceratobranchials. |
| 18. Maxillary bone. | 59. Upper epibranchial of first branchial arch. |
| 19. Infra-orbital ring. | 61. Epibranchials. |
| 20. Turbinals. | 62. Upper pharyngeals. |
| 22. Palatine bone. | 63. Gill-rakers. |
| 23. Hyomandibular bone. | 67. } Abdominal vertebræ. |
| 24. Pterygoid bone. | 68. } |
| 25. Entopterygoid bone. | 69. Caudal vertebræ. |
| 26. Quadrate bone. | 70. Hypural bone. |
| 27. Metapterygoid bone. | 71. Caudal rays. |
| 28. Operculum. | 72. Ribs. |
| 29. Stylohyal bone. | 73. Epipleural spines. |
| 30. Præoperculum. | 74. Interneural spines. |
| 31. Symplectic bone. | 75. Dorsal rays. |
| 32. Suboperculum. | 76. First interneural spine. |
| 33. Interoperculum. | 78. Rudimentary caudal rays. |
| 34. Dentary. | 79. Interhæmal spines. |
| 35. Articulary. | 80. Pubic bones. |
| 36. Angular bone. | 81. Ventral spine. |
| 37. } Epihyal and Ceratohyal bones. | |
| 38. } | |

CHAPTER I

FISHES: THEIR GENERAL CHARACTER AND STRUCTURE

Respiration—General Structure—The Air-Bladder—Fins—An Exception in the Flat-Fishes—Pectoral and Ventral Fins—The Vertical Fins—Divisions of the Body—External Design—Locomotion and its Organs—Scales—The Lateral Line.

To all mammals, birds, and to many reptiles, insects, and other animals, oxygen dissolved in water is useless for purposes of respiration ; and although there are certain warm-blooded vertebrate creatures, so remotely related to each other in the modern system of classification as the whale, the manatee, and the seal, which, having made the water their permanent habitation, have acquired many of the external characteristics of fish, yet all of these depend for existence upon periodical draughts of fresh air. Some reptiles and insects pass through their earlier metamorphoses, from egg to larva and pupa, in the water ; but on reaching the ultimate or perfect stage, they lose the peculiar apparatus which enables them to extract oxygen from their native medium ; they spend the rest of their lives breathing free air as terrestrial animals, and although they must visit the water to deposit therein the ova upon which the perpetuation of their species depends, they cannot remain submerged except on pain of death.

The class of Fishes, on the other hand, consists of those vertebrate animals which inhabit salt or fresh water, extracting therefrom the oxygen necessary to their existence by means of

branchiæ or gills.* Let these organs once get dry, and the animal perishes of suffocation just as certainly as a lung-breathing creature will do if kept under water. Some fish, like the stone-loach, die almost immediately upon exposure to the air ; but so careful is the directing power of Nature that no part of her dominion shall be void of life, that other fish are furnished with special mechanism for retaining moisture round the gills. Thus that strange creature, the African *Lepidosiren* (*Protopterus*), inhabits rivers which run dry every year, a catastrophe which would exterminate in a single season the whole population of an English stream. But *Protopterus* thrives under these trying conditions, attaining a length of six feet, and feeding ravenously upon other animals so long as the water lasts. When it fails, the fish sinks into the mud and forms around itself a kind of cocoon or capsule of its own slime, which hardens as the mud dries and forms a secure retreat, within which the animal lies torpid until the water returns with the ensuing rainy season. In this state the fish are often dug out and exported in the form of clay balls to zoological societies in Europe and America. Provided that evaporation is not caused by cracking or breaking the capsule, *Protopterus* may be released on arrival by soaking the covering, when the inmate is found quite lively and possessed of a prodigious appetite.

The water supply in temperate regions is not subject to such complete intermission as in the tropics ; nevertheless, natural gradients and artificial obstructions suffice to prevent the

* It is to be noted that the oxygen extracted from the water by fishes is not that which forms a chemical constituent thereof, but the free oxygen contained in the air which is dissolved in the water. Dr. Günther, in noting that very little oxygen suffices to purify the meagre volume of blood in a fish, cites the calculation that a man consumes fifty thousand times more oxygen than a tench. Now, as a man of ten stone weighs no more than seventy tench of two pounds each, if these two vertebrates were constituted alike, the man's requirement would be just seventy times that of a single tench.

ingress into certain areas of such fish as cannot survive somewhat prolonged exposure to the air. To meet this difficulty, as will be shown later, the common eel possesses a peculiar formation of gill-cavity, which retains enough moisture to preserve the activity of the branchial *laminae* so long as to enable the animal to perform considerable journeys overland.

The subaqueous life of fishes has led to the modification of their two pairs of limbs into fins, although the precise analogy of these organs to the legs of terrestrial mammals and reptiles may easily be lost sight of in certain genera and species by the development of unpaired, vertical, or median fins, which sometimes eclipse in size and prominence the original limbs, as in the perch (Fig. I., 75). Sometimes all external trace of the original limbs is lost, as in the eel, which has no ventral fins representing the hind legs, but has developed instead a continuous, confluent median fin, extending longitudinally over the greater part of both upper and lower surfaces. The total disappearance in the eel of those limbs which perform the office of propulsion in terrestrial animals is the more remarkable when it is considered that, of all British fishes, this is the only one that ever voluntarily leaves the water to travel by land. The eel, however, retains fully-developed pectoral fins, the homologues of arms in man.

Ray and Willughby, two excellent naturalists and collaborators of the seventeenth century, arrived at a definition of fishes which we recognise as perfectly sound and complete at this day. In the class of Fishes they placed all animals with blood, breathing by gills, provided with a single ventricle of the heart, and wholly or partly covered with scales, or naked. But the exclusion of whales from the class of Fishes involved in this definition proved so startling and unacceptable to the scientific men of the day, that Ray afterwards erroneously modified his terms so as to include warm-blooded animals inhabiting the water.

Occupying as they do the lowest place in modern classification of vertebrate animals possessing a skull and brain (Craniata), the structure of fishes generally is of a ^{General structure.} more plastic nature than that of more highly organised creatures. This not only brings about extreme, and often fantastic, modification of form in compliance with acquired habit and physical environment, but tends in certain genera to render the separation of species from mere trivial, local, or temporary varieties exceedingly difficult and dubious.*

For the central type of the class it is permissible to take the most highly organised of British fresh-water fish, the perch, although the superior swiftness and dimensions of the salmon, and its simpler outline, perhaps render it more satisfactory for that purpose. However, having borrowed Dr. Günther's excellent figure of the perch's skeleton to illustrate this chapter, let us take that fish as the standard of the class. Here we find an animal, whereof the specific gravity is greater than the water, suspended without apparent effort in that medium in a horizontal position, but with its sides vertical, moving in any direction with a minimum of friction at various degrees of speed. The first question suggesting itself is, Why does not the fish, being heavier than the water, sink to the bottom?

The explanation is not to be found complete in the external structure of the animal, but involves notice of ^{The air-bladder.} an internal organ peculiar to some, but not to all fishes—namely, the air-bladder. This consists of a sac placed in the abdominal cavity, and is considered to be a rudimental form of the lungs of higher animals. This bladder, which in some kinds of fish is connected with the pharynx by a pneumatic duct, is entirely closed in the perch, at least in

* Among British fishes this is notably the case with the *Salmonide*, and will be more fully discussed in the chapter dealing with that family.

adult individuals.* Within the bladder, gas, chiefly nitrogen, is secreted, whereby the buoyancy of the fish is regulated. It is said, on the authority of Siebold, that when, as happens in Lake Constance, perch are suddenly brought to the surface from a depth of twenty-five to thirty fathoms, the gas in the bladder, relieved from the enormous superincumbent pressure, expands, and, finding no escape, forces the bladder with some of the viscera out of the mouth of the fish.

This remarkable organ is present in all Ganoid fish, of which British inland waters only contain one, to wit, the sturgeon. In this order of fishes, it has greater or less connection with the respiratory system; but in the *Teleostei*, or Bony-skeletoned Fishes, which include the large majority of our native species, it bears no part in respiration, and would be termed with greater propriety the gas-bladder, seeing that its contents consist of nitrogen with an exceedingly small proportion of oxygen. In form and position the air-bladder, when present, varies very much. In the perch it is prolonged by two anterior channels into the skull, where it is connected with, and probably assists, the organ of hearing. In the loaches it is partly or wholly enclosed in a bony capsule extending from the vertebræ, and it is wholly absent from some species of bony fish and from the lampreys, which live habitually on the bottom.

The general buoyancy of the perch being thus secured by the air-bladder, whereby it is enabled to move freely at such distance from the bottom as it desires, the next point

Fins. requiring explanation is how it maintains a vertical position in the water—vertical, that is, in regard to its diameter from back to belly, for in regard to its length from snout to caudal fin its position is horizontal. A fresh-killed perch thrown into the water sinks slowly to the bottom; when the

* Dr. Günther is of opinion that a pneumatic connection between the air-bladder and the pharynx exists in all fish possessing an air-bladder at an early stage of their development.

gases generated by decomposition cause the body to rise to the surface it floats belly uppermost, the back being heavier than the lower parts. How comes it that without apparent effort a live fish swims or rests with its back uppermost? By the same unconscious adjustment of balance whereby a man stands and walks erect. True, a man's feet support him against the firm ground, whereas a fish is in every part in contact with a fluid medium; nevertheless, it is chiefly by the pair of ventral fins (Fig. I., 81, 82), homologues of the legs and feet in man, that the perch maintains its balance in the water. The pectoral fins (Fig. I., 53, 53A) doubtless assist in this function, for they are constantly in motion, but their chief use is in directing the course of the fish, in regulating its speed, in stopping its course, as when a rower "backs water," and in supporting the head, which, in the perch and most other fishes, is the heavier end. How little it takes to throw the creature off its lateral balance has been proved repeatedly by an experiment which it would be needlessly cruel to repeat: if the pectoral and ventral fins on one side are cut off, the fish falls over to the other side; if both pectorals are removed, the horizontal position is lost and the head sinks. The loss of an eye on one side does not cause a man to walk bent to the other side; but the eye of a perch is far heavier than a man's in proportion to respective gross weight, and a perch deprived of one eye keels over permanently to the other side. The action of the fins as balancers has been demonstrated by removing all the fins from a live fish. Thus mutilated, the animal when placed in the water floats belly upwards.

That the ventral fins are the chief organs of lateral balance is well illustrated by their total disappearance in such fish as live habitually in or rest upon muddy bottoms, like the *Muraenidae*, or Eel Family. Nevertheless the flat-fishes, which live entirely on the bottom, retain their ventral fins, which are useful in helping them to turn—a difficult operation in fishes of such abnormal design.

The mention of the Flat-fishes brings under notice the solitary and remarkable exception to the power of fish to balance themselves in the water, forming as it does the exclusive characteristic of the whole of one of the two divisions of the *Anacanthini*, or Spineless Fishes, an order containing such important food fishes as the cod, ling, halibut, turbot, sole, etc. The *Pleuronectidæ*, or Side-swimmers, commonly termed Flat-fishes, undergo a series of metamorphoses unique, so far as is known, in animated nature, and certainly among vertebrate animals. For some time after leaving the egg they remain perfectly symmetrical, swimming, like other fishes, back uppermost, and carrying an eye on each side of the head. But as they grow older they lose their balance, turn over on one side, and, being unprovided with an air-bladder, sink to the bottom, which they can only leave henceforward by active swimming. The side next the ground becomes pearly white, like the bellies of most vertical swimmers, the upper or exposed side assuming tints closely assimilating in colour with the surrounding sand, rocks, mud, or weeds. Lastly, the eye on the side which falls undermost pushes itself either round or through the head, so as to take up a new and useful position on the "business" side of the face. Owing to the mouth retaining the position it received at first, this contortion of the eyes imparts a most grotesque expression to the countenance.

It is no matter of accident which side happens to fall undermost. In the flounder, the only species which can be said to be a regular sojourner in English rivers, the fish reclines normally on its left side, though there are occasional exceptions to this rule. The turbot, brill, and some others recline on their right side ; but there occur also abnormal specimens of right-handed flounders and left-handed brill.

On the whole, having regard to the enormous inroads made upon the numbers of the various kinds of flat-fishes by trawls and other expedients, and to the numbers in which the

stock is maintained, their strange structure, which at first sight might seem to be a serious handicap in the struggle for life, must be pronounced a successful departure from the symmetrical scheme of Nature.

The fins count for a great deal in determining the affinities of genera and species among fishes.

The two pairs of horizontal fins—the pectoral and the ventral—have already been alluded to as the homologues of the anterior and posterior limbs of the higher vertebrates, and their functions described as principally those of balancers, steerers, and regulators of speed. They consist of a membrane, generally more or less transparent, supported and extended by rays. Sometimes this membrane of the ventral fins is brilliantly coloured, as in the perch and roach. The position of the pectoral fins is constant, just behind the gill-opening ; but that of the ventral fins is very variable. In most British fresh-water fishes they are situated far back on the abdomen, as in the Salmon, Carp, and Roach Families ; in some they are on the thorax, as in the perches ; in others on the jugular region, in advance of the pectorals, as in the burbot and miller's thumb ; in others, again, they are wholly absent, as in the eels and lampreys. In the determination of genera and species, the number of rays in the pectoral fins is held of little account ; but those in the ventral fins are of more importance, and, together with the rays of the dorsal fin, afford a sure guide to affinity in the *Acanthopterygii*, or Spiny-finned Fishes.

The unpaired, vertical fins are generally more conspicuous than the others. The most elementary form has been described by Dr. Günther as “ a simple fold of the skin surrounding the extremity of the tail,” and its gradual extension forwards along the upper and under surfaces may be traced in the development of fishes. Continuous in the primitive form of fish, this vertical fin soon became interrupted, and ranged itself in three principal masses—the caudal fin at

the extremity of the tail, the dorsal fin upon the back, and the anal fin upon the ventral line behind the vent. In the eel the vertical fin still remains continuous, running from a point on the dorsal line distant from the snout about twice and a half the length of the head, round the point of the tail and along the ventral line as far as the vent, which is three times and a half the length of the head from the snout. Locomotion is effected by a serpentine, lateral action of the whole spinal column, aided by an undulatory movement along the whole length of the fin.

The next stage is well shown in the flat-fishes, which have the caudal fin well separated from the continuous vertical fin, thereby divided into two fins, dorsal and anal. These spread fringe-like along both margins of the unsymmetrical body. In the flounder, the dorsal fin extends from the narrowest part of the tail to a point immediately over the left eye, and the anal fin is pushed so far forward as to displace the ventral fins, causing them to hold a position on the throat in advance of the pectorals. The vent also appears close below the gill-opening, in advance of the stomach and intestinal tract.

Besides acting as a keel, or steadier, the dorsal fin is constantly employed by most free-swimming fish as a supplementary rudder. In the *Acanthopterygii*, or Spiny-finned Fishes, it is usually too rigid for this purpose on account of the spinous rays; but some idea of its use may be obtained by watching a trout in an aquarium when it is swimming to and fro. The limits of the tank compel the creature to turn repeatedly; every time it does so, the dorsal fin may be noticed to be strongly bent in the direction the fish wants to go. It will be observed also that even when the trout is at rest, apparently asleep, with its body motionless, every one of the fins (except the second dorsal or adipose fin) are continually in motion as balancers.

Before proceeding farther in consideration of the functions of fins, it will be convenient to refer to the general design of

the body of a fish, and to specify its main divisions. Ichthyologists, then, recognise four main parts in a fish's body—the head, trunk, tail, and fins. The head is usually marked ^{Divisions of the body.} off clearly from the trunk by the gill-openings. It is only in primitive or archaic forms of fish like the lamprey, where the single pair of gill-openings is replaced by a number of small apertures, that any doubt can arise as to its limits. The boundary between trunk and tail is more arbitrary ; or, at least, is not easily to be recognised in the external form of certain fish. In fish formed after the standard type, like the perch and salmon, the trunk extends from the gill-opening to the vent, and contains the abdominal cavity, with the stomach, intestines, and generative organs. But in the flounder, as has just been described, as well as in some other fish, the vent is placed far forward, and the abdominal cavity, with its important contents, extends far behind it. In such fishes there is no external feature to denote the boundary between trunk and tail. Colloquially, what is really the caudal fin is spoken of as the tail ; but that is merely an appendage to the tail. The true tail is that part of the vertebral column which extends behind and beyond the abdominal cavity.

Reverting to the perch as our standard or typical fish, it will be observed how well designed is the body for easy ^{External design.} progression through a denser medium than the atmosphere. Length, lateral compression, a sharp prow and a fine-run aft, came to be recognised by man, so soon as his idea of navigation got beyond propulsion on a raft, as the desiderata in a vessel that was to make steady, rectilinear motion through an incompressible fluid. All these are manifest in the perch, although, as has been said above, they are brought to greater perfection in fish of migratory habits, such as the salmon, the mackerel, and the herring, which have to travel exceedingly long distances, and therefore have developed lines of the least possible resistance. Compare the outline and contours of any of these fish with those of

the miller's thumb, a fish which stands next in the British scale below the perches, and far above the salmon. It retains the fine-run aft, but the head is the broadest part of the animal, broader even than the capacious stomach, which is often distended with food. It has no air-bladder, and although actively predaceous, secures its prey in a very different way from the free-roving perch, for it lurks under stones, whence, propelled by its powerful tail and large pectoral fins, it launches itself in short, rapid rushes upon passing victims. It is for evolutionists to determine whether, in its departure from the typical form of Spiny-finned Fishes, the miller's thumb has adapted its habits to the form imposed upon it, or has forfeited the form of a free-swimming fish by the practice of skulking habits. There is this to be said for this curious little fish, that, inhabiting as it does shallow and clear brooks, it may have acquired the lurking habit in order to avoid herons and other enemies, against which it would stand an indifferent chance were it to swim abroad.

The caudal fin (Fig. I., 71), having become separate from the primitive continuous vertical fin, now becomes in most fishes the principal organ of propulsion. There are exceptions, of course, for the modifications in the structure of fish are innumerable and bewildering; but it is scarcely necessary, in dealing only with fresh-water species, to describe the peculiar means of locomotion in the rays, blennies, and hippocampi. The action of the caudal fin has been compared with that of a screw propeller; but the analogy is not perfect. There is no screwing motion; simply a rapid vibration of the tail from side to side. The flexible rays supporting the membrane of the caudal fin yield towards their points and present a flat, pushing surface of fin, which, acting like the backward stroke of an oar-blade, drives the fish forward.

The dorsal fin shows more frequent variation than any other. The rays are either spinous, all or some of them,

Locomotion
and its
organs.

forming the distinction of Acanthopterygian (spiny-finned) fishes, or they are soft, distinguishing Malacopterygian (soft-finned fishes). Spinous rays are simple and jointless, sometimes soft in substance, at other times stiff, bony, and sharp. Soft rays are transversely articulate or jointed, either simple or dividing into many branches. Not infrequently the jointing is disguised by ossification ; but the magnifying glass serves to distinguish such rays from true spines. Both kinds of rays often occur in the same fin, but in that case the spinous rays are invariably ranged in front of the others. Thus in the perch, which carries the dorsal fin in two separate parts, the first dorsal is supported by thirteen to fifteen spinous rays ; in the second dorsal are two spinous rays in front, followed by twelve or thirteen soft, jointed, and branched rays (Fig. I., 75). In Malacopterygian fishes the foremost fin-ray is often stiff and pointed, but it is not a true spine, and close examination will reveal the jointing. Among British fresh-water fishes there are some which have two rayed dorsal fins, such as the perch, the burbot, the lamprey, and the miller's thumb ; members of the Salmon Family invariably possess a rayed first dorsal, and a small rudimentary second dorsal without rays, called the adipose fin. The carps, loaches, pike, shad, and sturgeon display but one rayed dorsal ; while in the sticklebacks the place of the first dorsal is occupied by from three to fifteen isolated sharp spines, without a connecting membrane, behind which rises a bold second dorsal with from ten to twelve soft rays. The anal fin is generally upon the same plan as the dorsal fin, and, like that organ (Fig. I., 74), has its rays connected with the ribs by interhæmal spines (Fig. I., 79).

Little as the dorsal and anal fins have to do with propulsion, except in such creatures as the eel, the flounder, and the burbot, they are of great importance to locomotion. Deprived of them, a fish moves in an uncertain, erratic manner ; they act like the keel of a ship, keeping the animal on a straight course. In a ship only the lower section is submerged—a keel on deck

would be of no effect ; but a fish swimming in midwater makes use of a superior as well as an inferior keel. It is to be noted, however, that whereas the anal fin or inferior keel is usually more or less fixed, the dorsal or superior keel is erectile and depressible at pleasure. Its formidable armature of spines in the perch no doubt serves as a defence against predaceous creatures. As the rays of the dorsal and anal fins are arranged to correspond with the vertebræ of certain parts of the spinal column, they are pretty constant in number, and afford means of generic and specific classification. Nevertheless, they are subject, at least when very numerous, to a limited amount of variation.

The scales which protect the skin supply an external feature almost as characteristic as fins, but not so universal.

Scales. There are many instances of whole families of scaleless fish ; other families include both scaled and scaleless genera ; but it happens that among the fresh-water fishes of Great Britain five only—the sturgeon, the stickle-back, the miller's thumb, the lamprey, and the lampern—have no scales. In the first two the want of scales is compensated for by conspicuous bony scutes or plates, but the other three go naked. Even the eel of British waters, member of a family containing many scaleless genera, carries rudimentary scales, although its near relative, the conger, exhibits no trace of them.

In all Teleostean fishes the lateral line forms a very distinct feature. This is formed by a continuous row of perforated scales extending from the scaleless head to the root of the caudal fin. These perforations are connected with the muciferous duct which runs from the head along the body, and act as channels for the discharge upon the skin of that mucus which gives to the fish its peculiarly slippery surface. That seems to be the principal function of the lateral line—at all events it is the most obvious one ; but it does not account for the liberality of the nerve system with which

it is supplied, and from which some ichthyologists have inclined to infer the presence of a separate sense peculiar to fishes. The lateral line has no known homologue among the higher vertebrates. Some German ichthyologists affirm that the age of a large scaled fish, such as the carp, may be reckoned by examining the perforated scales of the lateral line. In its second year, they say, the fish develops a ring round the perforation, and another during each succeeding year.*

* *Deutsche Fischerei Zeitung*, January 13th, 1903. Mr. Crichton Browne, from whom I have received much valuable help in dealing with the migratory *Salmonidæ*, is carrying out systematic research upon this subject.

CHAPTER II

THE BREATHING APPARATUS OF FISH, THEIR TEETH, AND ORGANS OF SENSE

The Gills—The Teeth—The Sense of Touch—The Sense of Sight—The Sense of Hearing—The Sense of Smell.

AN attempt to deal with the internal anatomy of fishes would be not only beyond the scope of the present work, which aims no higher than to give a popularly intelligible description of the fishes found in British lakes and rivers, but would also exceed the powers of the author. Nevertheless, any review of these creatures which is more than purely superficial must take account of the manner in which their existence has been affected by residence in the water, and the degree in which their principal organs have been modified in conformity with their environment.

The breathing apparatus of fish is of peculiar interest, owing to the density of the medium from which it is its office to extract dissolved oxygen. The water
The gills. which enters the mouth passes through a cavity containing the gills or *branchiæ*, which consist of a series of cartilaginous rods, borne upon the convex or posterior face of the branchial arches (Fig. III., 58, 61), and flattened and tapered towards the free end. These are the branchial *lamellæ*, each of which is enclosed in a mucous membrane containing also the capillary blood-vessels. It is these capillaries which give the gills their brilliant red colour; they are fed by an artery which sends a branch into every pair of *lamellæ*, which

then divides into fine capillaries, in which the blood is oxygenated and returns purified into the circulatory system.

The water, having supplied the gills with oxygen, passes out through the gill-cover, which, in most Teleosteous fish,

takes the form of a slit, marking the division between the head and the trunk. It is protected by a thin, bony, external plate, called the operculum (Figs. I. and II., 28), which with other bones, termed,

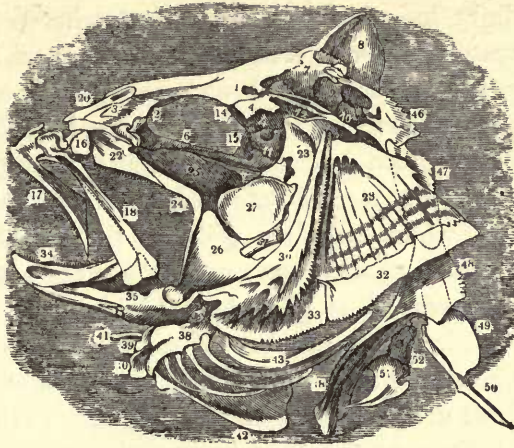


FIG. II.

BONES OF HEAD OF THE PERCH.
(After Günther.)

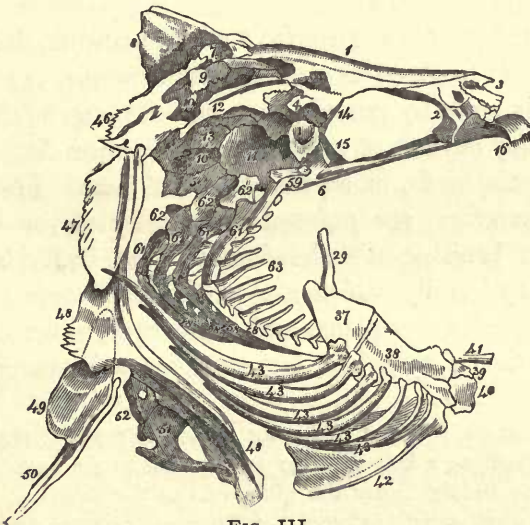


FIG. III.

BONES OF PART OF HEAD OF THE PERCH.
(After Günther.)

from their position relative to it, the præoperculum (*Ibid.*, 30), the suboperculum (*Ibid.*, 32), and the interoperculum (*Ibid.*, 33), form the gill-cover.

Now the gills are very delicate organs; a fish which may recover from frightful external injuries succumbs to a comparatively

slight lesion of the *branchiæ* ; wherefore, to close the gill-opening more effectively, its margin is further protected by a membrane supported upon one, two, or several bony rays, distinguished as the branchiostegals (*Ibid.*, 43).* As a protection from internal injury, such as might be caused by hard substances carried into the mouth by the water, the branchial rays, which carry the gills on their posterior face, are armed on their concave or anterior surface with a number of horny processes called gill-rakers (*Ibid.*, 63).

The usual number of gills in Teleostean fish is four pairs. The sturgeon, a Ganoid fish, has one additional imperfect gill in front of the others, and also what are called spiracles—external openings on the head to a canal leading into the pharynx, and connected with the respiratory system ; but it is destitute of branchiostegal rays.

The gill-opening, usually large and conspicuous in Teleostean fish, is very small in the eel ; and in the sub-class *Cyclostomata* (lampreys) it is replaced by seven small circular apertures on each side of the head behind the eye.

Most Teleostean fish swallow their food whole ; and as the great majority of British fresh-water fish are carnivorous, cap-

turing their prey by pursuit, it is upon their teeth
 The teeth. only that they have to rely, having no talons or claws like predaceous mammals, birds, or reptiles to assist them. The teeth of these fish, therefore, are pointed and prehensile, unsuitable for cutting or bruising withal. But our list includes many fish of the Carp Family which are partly herbivorous, browsing on the foliage of water plants and submerged grasses. The mouth in these fish is toothless, but they carry in their

* Often have I had occasion in spring fishing for salmon to remonstrate with my gillie, who, in unhooking a kelt in order to return it to the water, is apt to thrust his fingers rudely under the gill-covers as the most convenient way of holding a slippery customer. Such treatment usually causes the death of the fish, which it is the angler's duty to return to the river unhurt.

throat molar-like teeth arranged in one, two, or three series on the pharyngeal bones, suitable for bruising or pulping vegetable diet. Coupled with this masticatory apparatus, the palate in Cyprinoid fishes is padded with a thick, soft skin of whitish colour, rendered very sensitive by numerous nerves. This, it is supposed, may be the organ of taste, enabling carp to enjoy the flavour of their food, of which other fish are probably little sensible in the act of bolting it. Humanitarians might perceive in this an additional argument against carp-fishing; but I can testify from experience that a large salmon-hook deeply buried in the muscle of the human lower lip causes scarcely perceptible pain, although the process of extraction cannot be described as agreeable. In the *Cyclostomata* the teeth are adapted for a peculiar boring process, as will be described in dealing with the lampreys.

The degree in which fish are sensible of pain is a matter of speculation which has often been discussed, and still occupies the anxious thoughts of tender-hearted people who ^{The sense of touch.} are fond of angling. Not one of these but would abandon his cherished pursuit were he convinced, or did he even suspect, that the sufferings of a hooked salmon fighting for his life during twenty minutes of "play" were as excruciating as those of a rabbit struggling with torn flesh and shattered bones in an iron trap appear to be. The cruelty of the performance would be so shocking that salmon-fishing must necessarily be expunged from the category of sport, to which rabbit-trapping never has been admitted. And yet, startling as it may seem to persons who have never considered the matter deeply, the suffering of the two animals probably differs in intensity only in proportion to their relative intelligence. The rabbit suffers more acutely than the salmon because of its greater brain-power, and for the same reason a dog, accidentally trapped, undergoes sharper mental agony than a rabbit. As for the sheer physical pain, we are entitled to remember that merciful provision

of nature which causes a creature suddenly and violently attacked by a more powerful one to become unconscious of physical anguish, however grievously it may be wounded. But for that almost the whole scheme of nature, consisting of one perpetual process of the destruction of the weak by the strong, would offer an intolerable object of contemplation. Whether it be the overwhelming sense of terror or some other anæsthetic influence which renders the victim of a mortal crisis insensible to bodily pain, I know not, nor am I bold enough to speculate ; but I have the testimony of two men—one of whom had been mauled by a tiger, the other by a lion—that during the mauling they felt no pain. The first, indeed, said that he felt no apprehension, but a curious, soothed sensation of indifference. Paradoxical as it may seem, therefore, in view of the degree in which the bodies and organs of fish are known to be sensitive, it is probable that the mere physical pain suffered by a fish when hooked is very slight. The horror which a man feels on receiving a shocking wound is not caused by the present pain, but by apprehension of the consequences. An animal so intelligent as a dog may suffer by anticipation in the same way, though in a lower degree ; but a fish can have no dread of ulterior evils. The present is all it can be sensible of ; it cannot be haunted by apprehension of the painful operations of surgery and the tedium of convalescence. I have watched a trout which I have hooked in a clear chalk stream. It swam slowly and calmly away into deep water, and did not manifest the slightest violence or fear, *until it caught sight of me*. Then, as the vulgar saying is, “the band began to play.” The fish fought desperately, stimulated, not by pain from the tiny hook in his cartilaginous mouth, but by terror for the common enemy, man. Consequently, it may well happen that in strolling down a brookside you may be inflicting as much temporary suffering upon every trout that darts shadow-like from the shallows at your approach as if you had it securely

hooked. That headlong flight of the trout implies no bodily pain ; but if the fish had previously been hooked, the resistance offered by the rod and line would cause the said flight to assume the appearance of a series of struggles, as if the creature were in physical agony. My own belief is that the suffering caused by capture with hook and line is not one whit more severe than that effected with the net ; but, after all, it must be left to physiologists to estimate the acuteness of sensation in cold-blooded animals, lowest in the vertebrate scale. This much is certain : that, as a rule, fish are quickly sensible of anything touching the skin. This is important to their protection from the attack by predaceous species, to which most of them at some or all periods of their lives are constantly exposed.

In some species special organs of touch have been developed, such as the barbules which depend from the lips of the carp, the barbel, the loach, the sturgeon, and many others. These appendages are exceedingly sensitive, and are used by these fish as feelers, in pursuit of food. In man, the extremities of the anterior limbs have become specialised as organs of touch ; but the homologues of these limbs in fish—the pectoral fins—do not generally seem adapted for this function, although in the gurnards some of the rays, separated from the fin and well supplied with nerves, suggest the office of fingers or feelers.

The visual powers of fish offer a subject of much interest, not only to the angler, whose purpose it is at once to excite and delude them, but to every observer of nature, because the sense of sight is that which appears to have received in fishes a higher development than any other. The first peculiarity apparent in a fish's organ of sight is the total absence of a true eyelid. Some marine and exotic species, indeed, as well as the British shad, can extend a fold of skin over the eyeball from the posterior and anterior parts of the orbit, leaving a *vertical* transparent slit over the pupil ; but, with this exception, none of the fish of our

lakes and rivers can close an eye from the day it is hatched from the egg till the hour of its death. Man has been described as an animal that weeps, and makes others to weep ; but a fish can shed no tears, having no lachrymal duct. Nevertheless, in the majority of fishes the eye is a very complex and highly developed organ. To compensate for the absence of eyelids, the skin of the head covers the eye, becoming perfectly transparent where it passes over the orb. Moreover, the cornea, or exposed part of the orb, is flat, instead of convex as in terrestrial vertebrates, and therefore less liable to receive external injury ; but in the general arrangement of the component parts—pupil, iris, crystalline lens, sclerotic coat, vitreous humour, and retina—the eye resembles those of the higher animals. Dr. Günther has shown by a vertical section magnified 350 times that the retina of a perch is not less complex than that of one of the higher mammals, composed of nerve cells, granular layers, and a layer of rods and cones, occupying the same relative positions to each other as they do in the human eye, and bearing similar proportion to each other. The presence of the rod-and-cone layer seems to justify the assumption that perch have a well-developed perception of colour.* It should be mentioned as an interesting point in comparative anatomy that in the sub-class of *Cyclostomata* (lampreys), the optic nerves pass from the brain to the eyes without crossing—the right lobe being connected with the right eye and the left lobe with the left eye. In *Teleostei* (perch, etc.) they are crossed, the nerve from the right

* The colour sense in fish has been the subject of much controversy among anglers, some of whom are anxiously particular about the precise hues acceptable to surface-feeding fish. My own experience goes to convince me that salmon, and even highly-educated chalk stream trout, are singularly indifferent to the colours of flies offered to them, taking a scarlet or blue fly as readily as one closely assimilated to the natural insect. Probably the position of the floating lure, between the fish's eye and the light, interferes with any nice discrimination of hue from reflected rays.

lobe going to the left eye, and *vice versa*, but are not united ; but in *Palæichthyes*—as in the sturgeon—the two nerves cross and are fused together at the point of crossing, just as they are in the higher vertebrates.

The question whether fish can hear is often debated among anglers as hotly as whether they can distinguish colours. As every kind of fish, except the lowest of all, the lancelet (*Brachiostoma lanceolatum*),* is provided with a special acoustic apparatus, it seems unreasonable to deny that fish possess the faculty of hearing. Water surface is well known to facilitate the transmission of sound horizontally through air, but it remains in doubt in what degree atmospheric sound-waves communicate themselves to, and are transmissible *within*, the water.† At all events, the acoustic apparatus of fishes is not on the same plan as that of terrestrial vertebrates. The ear has no *tympanum* or drum, neither is there any external orifice to the auditory chamber. In Teleostean fishes there is a labyrinth consisting of a vestibule connected with three semicircular canals, filled with fluid and contained among the cranial bones or within the cranial cavity. On each side of the base of the cranial cavity is placed a sac communicating with the vestibule. Sometimes each sac is divided into two unequal receptacles, each containing a stony concretion termed an *otolith*, and in the vestibule is another of these concretions, in contact with the ends of the acoustic nerve. In some species communication between the ear and the outer world is facilitated by openings through the skull, closed externally only by skin or very thin bone. In the perches,

* A creature with colourless blood and no brain, excluded on that account by Haeckel from the branch (*phyla*) of fishes, and isolated among vertebrates as the branch *Acrania*, or brainless animals. With less apparent reason Haeckel denied a place among Fishes to the *Cyclostomata* (lampreys), which he constituted a separate branch, *Monorrhina*.

† An instance in point from my own observation will be found on page 56.

herrings, carps, and other families, there exists a more or less elaborate connection between the air-bladder and the auditory process.

In the lampreys the labyrinth consists only of two semi-circular canals and a vestibule.

Of the extent to which fishes exercise and are guided by the sense of smell very little is known. Early writers upon angling ^{The sense of smell.} prescribe various odoriferous unguents, calculated to attract fishes to the bait ; but as the use of such anointing has been entirely discontinued in modern practice, these prescriptions must be regarded as purely empirical. Had assafoetida, oil of ivy, or the other strong-smelling substances, recommended proved efficacious, fishermen would have been slow to abandon them. It is said that trout are drawn from long distances by the odour of potted salmon-roe ; but of this I cannot testify from observation, the use, sale, or possession of that article being contrary to law. Nevertheless, seeing that all fishes, even the brainless lancelet, possess olfactory organs, it is certain that they possess also the power of smelling. But the exercise of this faculty differs from that of terrestrial vertebrates in being totally disconnected with the machinery and function of respiration. The "breath of his nostrils" is the life of man ; his olfactory nerves vibrate to the odoriferous atoms borne on the atmosphere ; he cannot smell without performing half the complete act of respiration—that of inhaling ; and he cannot inhale properly, *i.e.*, through the nostrils, without being sensible of any odour strong enough to excite his olfactory nerve. But fish breathe through the mouth and gills, with which the nostril has no connection whatever ; * the act, therefore, of admitting water to the nasal sac, whether it be voluntary or unconscious, is quite independent of breathing.

In British fresh-water fish, with the exception of one

* Except in the *Dipnoi*, such as *Lepidosiren* and *Protopterus*, which spend part of the year torpid in the dried mud of rivers.

family, the nostrils bear a similar relative position to the mouth as in the higher vertebrates ; they are covered externally with skin pierced by two openings, the foremost of which is fitted with a valve, the posterior being usually open. Each nostril leads into a separate sac with a membranous lining, in which the olfactory nerve spreads its ramifications. The exception to this general arrangement is a remarkable one, furnished by the lamprey and lampern, which have but a single nostril situated on the top of the head, slightly in front of the eyes.

Classified List of British Fishes

Class PISCES

SUB-CLASS.	ORDER.	FAMILY.	GENUS.	SPECIES.	ENGLISH NAMES.
Palæichthyes .	Ganoidei . . .	Acipenseridæ .	Acipenser . .	sturio . . .	Sturgeon
Teleostei. . .	Acanthopterygii	Percidæ . . .	Perca . . .	fluviatilis . .	Perch, Barse (<i>E. Anglian</i>)
"	"	"	Labrax. . .	lupus . . .	Bass, Sea-perch
"	"	"	Acerina . .	cernua . . .	Ruffe, Pope
"	"	Cottidæ . . .	Cottus . . .	gobio . . .	Bullhead, Miller's Thumb, Tommy Logge, Cull, Tom Cull
"	"	Gastrosteidæ .	Gastrosteus .	aculeatus . .	Three-spined Stickleback
"	"	"	"	spinulosus. .	Four-spined Stickleback
"	"	"	"	pungitius . .	Ten-spined Stickleback
"	Anacanthini .	Gadidæ . . .	Lota . . .	vulgaris . .	Burbot, Eel-pout, Coney-fish
"	"	Pleuronectidæ .	Pleuronectes .	flesus . . .	Flounder, Fluke, Butt (<i>Yarmouth</i>)
"	Physostomi . .	Cyprinidæ . .	Cyprinus . .	carpio . . .	Carp
"	"	"	Carassius . .	vulgaris . .	Crucian Carp, The Crowger, Gibel
"	"	"	"	auratus. . .	Gold-fish
"	"	"	Barbus . . .	vulgaris . .	Barbel
"	"	"	Gobio . . .	fluviatilis . .	Gudgeon
"	"	"	Leuciscus . .	rutilus . . .	Roach
"	"	"	"	erythrophthalmus	Rudd, Red-eye, Fin-scale, Shallow
"	"	"	"	cephalus . .	Chub, Chevin, Chavender, Skelly, Loggerhead, Poll, Pollard, Lob, Bottling
"	"	"	"	vulgaris . .	Dace, Dare, Dart
"	"	"	"	phoxinus . .	Minnow, Pink, Baggie, Baggit, Banny, Jack Larel, Jack Sharp, Meaker, Mennot, Minim, Peer, Shadbrid, Minnin (<i>Scots</i>)
"	"	"	Tinca . . .	vulgaris . .	Tench
"	"	"	Abramis . .	brama . . .	Bream, Bellows-bream
"	"	"	"	blicca . . .	White Bream, Breamflat, Tinplate
"	"	"	Alburnus . .	lucidus . . .	Bleak
"	"	"	Nemachilus .	barbatulus .	Loach, Stone-loach, Colley, Beardie

Classified List of British Fishes (*continued*)

Class PISCES

SUB-CLASS.	ORDER.	FAMILY.	GENUS.	SPECIES.	ENGLISH NAMES.
Teleostei . .	Physostomi . .	Cyprinidæ . .	Cobitis . . .	tænia . . .	Groundling, Spined Loach
"	"	Esocidæ . . .	Esox . . .	lucius . . .	Pike, Luce, Jack, Pickerel, Gedd (<i>Scots</i>)
"	"	Salmonidæ . .	Salmo . . .	Salar . . .	Salmon
"	"	"	"	eriox . . .	Sea-trout, Bull-trout.
"	"	"	"	trutta . . .	Salmon-trout, Sea-trout, White Trout, Whiting, Whiting, Fin-nock, Herling, Sprod, Mort, Lammassen, Scurf, Cochivie, Fordwich Trout
"	"	"	"	fario . . .	Trout, Brown Trout, Yellow Trout, Brook-trout, Lake-trout
"	"	"	"	alpinus . . .	Char
"	"	"	" (Salvelinus)	alpinus . . .	Char
"	"	"	Osmerus . .	eperlanus . .	Smelt, Sparling
"	"	"	Coregonus .	clupeoides .	Powan, Gwyniad, Schelly, Fresh-water Herring
"	"	"	"	pollan . . .	Pollan
"	"	"	"	vandesius . .	Vendace
"	"	"	Thymallus .	vulgaris . .	Grayling, Umber
"	"	Clupeidæ . . .	Clupea . . .	alosa . . .	Allis Shad, May Fish, Alewife
"	"	"	"	finta . . .	Twait Shad
"	"	Muraenidæ . .	Anguilla . .	vulgaris . .	Eel
"	"	"	"	latirostris .	Grig, Glut, Broad-nosed Eel
Cyclostomata .	Marsipobranchii	Petromyzontidæ	Petromyzon .	marinus . .	Lamprey, Sea-lamprey
"	"	"	"	fluviatilis .	Lampern, Nine-eyes, Seven-eyes, Stone-grig, June-ba
"	"	"	"	branchialis .	Mud-lamprey, Pride

CHAPTER III

THE STURGEON

Appearance—Habits.

First Sub-Class . **PALÆICHTHYES: ARCHAIC FISHES**

Second Order . . **Ganoidei: Ganoid Fishes**

Fourth Sub-Order **CHONDROSTEI: GRISTLY FISHES**

THE sub-class *Palæichthyes*, as its title implies, embraces the most ancient types of fish known. It stands, says Dr. Günther, in similar relation to the *Teleostei*, or Bony-framed Fishes, as the marsupials do to placental mammals. It is divided into two orders—the *Chondropterygii*, or Gristly-finned Fishes, consisting of the sharks and rays, and the *Ganoidei*, or Ganoid Fishes, to which belongs the only individual in the sub-class frequenting British fresh waters. The fourth sub-order in this sub-class is named *Chondrostei*, or Gristly Fishes, and this again is divided into two families—the *Acipenseridæ*, or Sturgeon Family, and the *Polyodontidæ*, or Many-toothed Family.

ACIPENSERIDÆ: THE STURGEON FAMILY

Although inferior in rank of organisation to the *Teleostei*, or Bony Fishes, the Sturgeons may claim the first place in the list of British fresh-water fish, not merely because they exceed all others in size—might gives no right in classification—but because of the position of their family and order

in the oldest, and therefore the first, sub-class of the class of Fishes.

The Sturgeon Family includes two genera only, whereof the first, *Acipenser*, consists of about twenty species, all bearing a remarkable resemblance to each other, and comprising the largest fresh-water fish of the Northern Hemisphere. The body is much elongated and nearly cylindrical; the skin is protected by ridged bony plates or "scutes," arranged in five longitudinal rows, one along the back, two along the upper region of the sides, and two along the lower or ventral region. The sharply-angled keels or ridges of these plates give the fish a strangely antique appearance, and suggest a pentagonal form of body. The interval between the plates is covered with small bony scales. The skull and framework of the head is cartilaginous or gristly, well protected by external bony armour; the entire skeleton also is gristly, and the vertebral column is prolonged so as to support the upper and longer lobe of the caudal fin.

The snout projects far beyond the mouth, which is very small relatively to the size of the fish, toothless, transverse, with thick lips capable of protrusion like a short trunk. Between the tip of the snout and the mouth hang four fleshy barbules or wattles, arranged in a straight transverse row. The arrangement of the fins corresponds to that usual in Teleostean fishes, subject, however, to some modification in position. Thus the dorsal is set very far back, close to the tail fin, the anal fin being opposite but slightly in rear of the dorsal. The pectoral fins are set low, at the side of the throat, and are long and powerful; the ventral fins are placed far back, just in front of the vent.

The Sturgeons are built on a scale suggestive of destructive habits and formidable rapacity; but there exist, in truth, no more inoffensive creatures. Like that of the whales, the diet of the sturgeon consists of lowly organisms which nobody misses, and the fish is incapable of inflicting injury on man.

The Sturgeon (*Acipenser sturio*)

FIN FORMULA.

Pectoral: 31 rays, of which the first is very strong and bony.

Caudal: Upper lobe, 39 rays; lower lobe, 81 rays, whereof sixteen are bony.

In all the fins, the rays are generally finely denticulated.

TEETH.

None.

The Sturgeon is the largest fish frequenting British inland waters. It is of noble proportions, attaining sometimes a length of 18 feet, and weighing many hundredweights. Frank Buckland received one taken in a deep-sea trawl off Heligoland, and prepared a mould for making a cast of it. He was prevented by illness from finishing the work, but he has left it on record that this specimen measured 11 feet 4 inches in length, and weighed 623 lb.

I have found no record of sturgeon so large as this taken in British waters, but while these pages are being prepared for the press, information comes to hand of two considerable fish of this species. One was taken near the Leven estuary in Morecambe Bay, measuring 8 feet 1 inch in length, 4 feet 8 inches in girth, and weighing 448 lb. The other was caught in the Conway, just below Talycarn Bridge, and differed materially in proportions from the first. Although 11 inches longer than the first, it girthed only 3 feet 6 inches, and weighed but 320 lb.

The origin of popular names for wild animals is always interesting to both naturalists and etymologists. Generally they are roughly descriptive, or arise from some conspicuous feature or characteristic. Dr. Skeat, who holds the foremost place among modern English philologists, has traced the name "sturgeon" to a Teutonic source, the same that gave the Anglo-Saxon *styrian*, to stir, and interprets it to mean "the stirrer." In Anglo-Saxon the fish was called *styria*, just as in Swedish

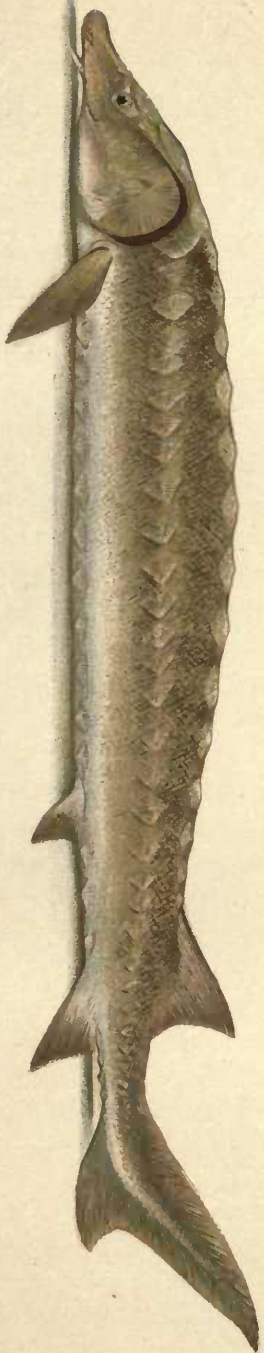


Photo by Thomas Hoe

THE STURGEON (*Acipenser Sturio*)

about $\frac{1}{2}$ Natural Size

and Danish it is called *stör*, from *störa*, to stir; and the word found its way into Low Latin as *sturio*. The allusion is to the ground-feeding habits of the fish, wallowing and raking at the bottom in search of food. In this country we have few opportunities of studying the behaviour of the sturgeon, for, although a tolerably frequent visitor to our rivers, it is only the stragglers that wander to our shores, and we never witness the migration of vast numbers which is such a notable seasonal feature in the mightier rivers of the Continent. Therefore the Germanic conquerors of England must have brought with them the name of the fish whereof they were familiar with the habits.

The adult sturgeon is so distinct in appearance that it can never be mistaken for any other kind of fish; and immature specimens are not likely to occur in this country, owing to lack of spawning accommodation. **Appearance.** No doubt these fish, when they ascend our rivers, do so with the intention of reproduction; but their great size is so much out of proportion to the scale of our insular waters, and betrays their presence so surely, that it is very improbable that they ever succeed in depositing their ova. In form the sturgeon alters greatly in progressive stages of growth. The snout of young fish is very long and turned upwards; it shortens and broadens with maturity, and loses the upward turn.

In colour the adult fish varies from reddish-brown to yellowish- and bluish-grey on the back; the bony plates are grey, the belly silvery white, and the iris yellow. The plates along the back usually number from eleven to thirteen; those on the sides six- or seven-and-twenty in each line; those on the ventral lines nine or ten in each.

The sturgeon is what is termed an anadromous fish—literally, a “running-up” fish, or one that ascends rivers from the sea at regular intervals in order to spawn. **Habits.** This operation takes place in spring or early summer, according to latitude and temperature. The

female is enormously prolific, some individuals containing upwards of three millions of eggs. Frank Buckland weighed the ovaries in a female sturgeon, 9 feet 6 inches long, taken in June 1877 at Chepstow, on the Wye. The weight of this fish was $3\frac{1}{2}$ cwt.; that of her eggs 27 lb. The collection of the spawn of this and other species of sturgeon before it is shed, and its conversion into *caviare*, form an important summer industry near the mouths of the great rivers of Eastern Europe. The most important scene of operations is at Rubinsk, on the Volga, where as many as one hundred thousand people collect, it is said, in spring, and await the approach of the fish. Of this, notice is given by an outlook upon a height, and as soon as the shoal is within the channel, nets, spears, and gaff-hooks are set to work, and the carnage begins. Thousands of these great fish are sometimes landed in a single day; the *caviare* is taken out, washed in vinegar, and spread upon boards in the open air. Then it is vigorously salted by hand-rubbing, pressed in bags and packed in kegs for the market. In Russia it is very largely consumed as an article of diet, carrying the common people conveniently over the three periods of fasting; but in this country it is only known as a superfluous savoury for jaded palates. The flesh is said to be wholesome and palatable, being described as resembling a compound of veal and eel, with a flavouring of lobster. The air-bladder is substantial, and is carefully dried by the fishermen to be sold and converted into isinglass. Altogether the sturgeon is a valuable fish economically, and vast though the numbers be of the several species frequenting Russian and Asiatic waters, the ruthless extent to which they are slaughtered at the spawning season must eventually tell its tale upon the race. Mr. Seeley states, but does not cite any authority, that in the middle of last century "it was rare to see a fish in the Vienna market of less than 100 lb., and now (1886) only very small ones are caught."*

* *The Fresh-Water Fishes of Europe*, p. 383.

The sturgeon requires an immense amount of food to nourish his great carcase, and seeing what a small mouth he has to collect it withal, it behoves him to be diligent and active. Hence his name, "the stirring one," for he routs bravely with his nose in gravel, sand, and mud, his sensitive barbules apprising him of the presence of edible bodies, and his extensile lips enabling him to suck them in. No vegetarian, he lives chiefly on worms, small fish, molluscs, and crustaceans. In captivity, as he may sometimes be seen at the Brighton Aquarium, he devours enormous quantities of lug-worms. Yet his boldness and voracity are of no service to the angler. A sturgeon eight or nine feet long were indeed a worthy quarry to contend for, but at present he cannot be reckoned among our sporting fishes.

Occasionally an American species, *Acipenser maculosus*, finds its way across the Atlantic, and is taken in British estuaries, but not with sufficient frequency to earn for it a place in our native fauna. A variety of sturgeon, with a snout broader and thicker than ordinary, has been distinguished as a species under the title of *Acipenser latirostris*, but Dr. Günther refuses to admit it to specific rank.

CHAPTER IV

THE PERCH FAMILY

The Perch—Protective Coloration—Affinities of the Perch—Teleostean Fishes—The Zander, or Pike-Perch—Outward Appearance of the Perch—Size—Habits—Reproduction—The Hearing of Fish—Perch as Food—How to Cook Perch—Angling for Perch—The Paternoster—Float-Fishing—Spinning and Fly-Fishing—The Bass, or Sea-Perch—Angling for Bass—The Ruffe, or Pope—Outward Appearance—Angling for Pope.

Second Sub-Class **TELEOSTEI: BONY FISHES**

First Order . . **Acanthopterygii: Spiny-finned Fishes**

First Sub-Order . **ACANTHOPTERYGII PERCIFORMES: PERCH-LIKE SPINY-FINNED FISHES**

IN the sub-class *Teleostei*, or Bony Fishes, are comprised the great majority of fishes at present inhabiting the waters of the earth. Geologically they are more modern than the *Palaichthyes*, or Archaic Fishes, the Teleostean type not having been recognised in a fossil state in formation older than the chalk; nevertheless they are not to be regarded as descended from the older extant forms, but as a separate race of creature, sprung, probably, from a common source, attaining by independent evolution a more successful organisation than the other, and, in virtue thereof, superseding it largely in possession of the waters.

The most obvious distinctions of Teleostean fish are that the skeleton, instead of being gristly, is bony, and the vertebræ of the spinal column are completely formed, justifying the general term Teleostean—completely bony.

The sub-class *Teleostei* is arranged in six orders, whereof the first—*Acanthopterygii*, or Spiny-finned Fishes—is distinguished by the presence of spinous rays, more or less sharply pointed, in one or more of the fins. This great order is again subdivided into nineteen sub-orders, the first of which is that of *Acanthopterygii perciformes*, or Perch-like Spiny-finned Fishes, a well-defined clan, with spinous dorsal fin well developed, and a soft anal fin. The first family in this sub-order is that of the *Percidæ*, or Perches.

PERCIDÆ: THE PERCH FAMILY

The Perch (*Perca fluviatilis*)

FIN FORMULA.

First Dorsal: 14 or 15 spines.
Second Dorsal: 1 spine or 2, 13 or 14 rays.
Pectoral: 14 rays.
Ventral: 1 spine, 5 rays.
Anal: 2 spines, 8 or 9 rays.
Caudal or tail fin: 17 rays.

TEETH.

Villiform, without canines.
 On the palatine bones
 and vomer. None on
 the tongue.

The eye of one peering curiously into a clear lake, or the tranquil depths of an English river, may be attracted by the gliding movement in mid-water of certain groups
The Perch. of dark vertical bars, like shadows. "Look at the perch!" he will exclaim, if he knows anything about aquatic life, all unconscious that he is really saying, "Look at the striped fellows!" For that is the root meaning of the English word "perch," which has found its way into our vocabulary through the French *perche*, the Latin *perca*, and the Greek *πέρκη*, spotted or pied, all of common origin with the Sanskrit *pricni*, and connected with the Latin *spargere* and English *sprinkle*. In East Anglia and Lancashire the perch is known as the barse, representing the Anglo-Saxon *bærs*, a word which is glossed "perca, lupus," in Ælfric's Glossary. This is the same as the modern German *barsch* and the Dutch *baars*, both signifying

the perch, and to some careful etymologists it has appeared that *barsch* has been formed from *perch* by the softening of the initial consonant ; but Professor Skeat is of opinion that they are different words. Local pundits explain the East Anglian name "barse" to have arisen from the bars or stripes which distinguish this fish among all others. In fact, this explanation has been solemnly offered in a recent work of sterling merit, and highly readable withal, *The Practical Fisherman*, by J. H. Keene,* who quotes Mr. Manley, another writer upon angling, as his authority.

The perch is, indeed, well named "the striped fellow." But for those conspicuous dark bars, he would be almost invisible in his native haunts, moving ghost-like among waving water-weeds and over brown pebbles, which accord closely with the ashen-green tints that form the ground-colour of his back and sides. Indeed, the perch is quite the most conspicuous denizen of British inland waters, and the decorative effect of these stripes acts strangely at variance with the usual protective scheme of colour conferred upon fish and other animals exposed to attack from more powerful predatory species.

This is the more puzzling inasmuch as, in other respects, the perch is not without provision for escaping observation.

Protective coloration. It possesses in a high degree that peculiar property of skin which causes so many fish to adapt themselves to their temporary background by assimilation to the prevailing tints thereof. When the perch haunts a dark bottom, the hue of its skin deepens ; in a chalk stream, where the bottom is light-coloured, this fish parts with its deep olive tints and assumes a yellowish-grey colour. But the characteristic dark bars always remain in the same relation of conspicuous contrast to the general skin tint.

There is no evidence that these protective changes depend in the slightest degree upon the volition of the fish, nor that

* London, 1881.

they arise from emotional excitement, as is the case with the rock goby (*Gobius niger*), a marine fish, which turns from ashen grey to a dark, angry smoke-colour when in pursuit of prey. In the perch, as in the common trout and many other fish, the skin responds sympathetically and automatically, but by a mechanism not hitherto satisfactorily explained, to the various colour rays reflected from surrounding objects.

The degree in which fish of the Perch Family possess this sensibility to colour environment, however temporary, happens to have impressed itself upon my attention more forcibly in the case of another member of the family, namely, the American black bass (*Micropterus salmoides*), than in that of the common perch. The black bass bears a strong general resemblance to the British perch. Some years ago, having reared a number of these bass from the yearling stage in a disused mill-pond, and desiring to turn them into a large lake for naturalisation, I had the said pond drawn with a net. The first draught brought out half a dozen bass nine or ten inches long. The general tint of these fish on back and sides was a rich dark olive-green. Placed in a wash-tub, whereof bottom and sides had been bleached to a whitish hue, they appeared very dark indeed. A cloth was laid over the tub to prevent the bass leaping out, and the net was made ready for a second draught. In fifteen or twenty minutes, when some more fish were brought to the tub, the first lot had completely changed their tint, being closely assimilated to their new background.

While treating of the perch, I have dwelt in some detail upon this phenomenon of colour change, not because it is the only fish of that family, but because it is the only British fish in which the obvious intention of such change, namely, concealment, is defeated by the permanence of conspicuous markings. In other respects, similar aids to invisibility are present in the perch as have been observed in other vertebrates, both terrestrial and aquatic. For instance, the belly of this fish is pure white, as is the case with so many

mammals and birds—an arrangement which has been shown by Professor Thayer to be protective, by reason that it neutralises the optical effect of that shade in which the lower parts of animals normally remain. It does more : it not only neutralises the *shade*, but, by means of the light reflected from the white underparts, it weakens the *shadow* cast upon the ground or bottom of the water by the body of the animal. Everybody who is practised in detecting salmon or trout in a river knows that the presence of the fish is more often betrayed by its shadow cast on the bottom than by a view of the fish itself.

The Teleostean type of fish has developed so much vigour, and is endowed with such effective equipment for attack and defence, as to secure for it a marked advantage in the struggle for life ; and among them, none have been more successful than the Perch Family. At the present time their genera and species, bewildering in number and variety, abound in all waters, both fresh and salt, throughout the temperate and tropical regions.

It is interesting to trace the dominant features of the original type in the enormous variety of forms which have been evolved under different climatic and other physical conditions. The tendency to brilliant colouring, more or less suppressed in species inhabiting confined waters, breaks out in some of the marine perches into extravagant and startling combinations ; as if the armature of spines with which all members of the family are furnished enabled them to dispense with the protective coloration accorded to less warlike creatures.

Two members of the genus, *Perca gracilis* from Canada and *Perca Schrenkii* from Turkestan, differ very little from the species with which we are so familiar at home. The waters of Europe contain several kinds of perch which do not extend to Britain. In the apron (*Aspro vulgaris*) of the Upper Rhone and other rivers of Central France, the body has become strangely elongated and the head compressed

in conformity with it ; but the stripes, spined fins, and other characteristics of the family are easily recognised under the modifications.

In North America the place filled in the British angler's esteem by the common perch is occupied by a nearly related genus, the black bass (*Labrax*).^{*} *Percichthus*, differing from *Perca* chiefly in the number of spines, is a genus comprising the fresh-water perches of South America. The Nile and other African rivers nourish a great perch, known to science as *Lates niloticus* ; while *Lates calcarifer*, the perch of the Ganges and other Indian waters, is indeed a formidable fellow, sometimes attaining the length of five feet. This fish, which is held in high gastronomic esteem, has developed the anadromous habit ; that is, it resorts alternately to fresh and salt water. Our own perch show a slight tendency in that direction ; those of the Norfolk Broads entering brackish water, where, it is said, their flesh acquires a superior flavour from a diet of shrimps. The Indian perch, called "Cockup" by the inhabitants of Calcutta, who greatly appreciate its excellence as food, extends as far as the waters of Queensland ; but in Australia a third species of *Lates* takes its place (*L. colonorum*) ; and in South Australia we first come across a valuable food fish of the Perch Family, the Murray River cod (*Oligorus nacquariensis*), famous for its excellent flesh and huge proportions. It sometimes weighs nearly 100 lb., and gives good sport to anglers. But these must not be fastidious in their art, nor scorn such tackle as will carry the most successful bait, which is said to be half a pound of raw mutton. A seafaring relative of this great perch, *Oligorus gigas*—the "Hapuku" of the Maoris—which frequents the coast and reaches of New Zealand, has been taken weighing as much as three or four hundredweight.

One of the coral fishes, so called because they haunt the coral reefs of tropical seas, is a highly-developed perch (*Apogon frenatus*). It is brilliantly coloured, and we may trace in its

^{*} Placed by American naturalists in a separate genus, *Micropterus*.

contour the distinguishing features of the type. The same characteristics may be seen in the sea-perches of the Indian Pacific, such as *Diagramma orientale*. These fish sometimes reach a length of three or four feet. The features of the family are greatly exaggerated in another sea-perch of the Indian Ocean, *Gerranus altivelis*. People bathing at Aden and the Seychelles have been known to be attacked by a gigantic perch—a species of *Serranus* not accurately identified—and to have died of the injuries inflicted on them.

Most of these fish of the Perch Family, bewildering in their variety, remain faithful to their title of the striped or barred fish. Sometimes the distinction is reduced to a single blotch on either side, as in *Mesoprion monostigma* from the Indian Archipelago. So strongly have the features most characteristic of our British perch, namely, its stripes and spiny fins, been impressed upon the order *Acanthopterygii*, that they appear in an exaggerated degree in the next family to the *Percidæ*, namely, the *Squamipinnes*, or scaly-finned fish. These are distinguished from the true perches by the scales which extend over the membranes of dorsal and anal fins. A few only of the innumerable genera and species of *Squamipinnes* may be mentioned as illustrating the strange modifications which physical surroundings impress upon the original type.

The archer fish—"Ikansumpit" of the Malays (*Toxotes jaculator*)—earns its living in a truly sporting, refined manner. It shoots its prey, having the power of discharging a drop of water at an insect hovering over the surface of the water or resting on a leaf with so true an aim as to bring it down, when the archer promptly swallows it. *Chelmo rostratus*, a fish of the tropical seas, belonging to the same family of *Squamipinnes*, exercises the same curious art.

Before closing these observations on the relations of the perch, mention must be made of a very formidable member of the family, the pike-perch, or zander (*Lucioperca sandra*), a large fish running to the weight of 20 lb. or 30 lb.,

which abounds in Eastern Europe, and is found as far west as Schleswig-Holstein. It is said to be a desirable fish for The Zander, naturalisation in British waters, but, although its ^{or} Pike-perch flesh is of a high quality, and it is a good sport-
(*Lucio perca*). ing fish, the utmost discretion should be observed in distributing it; for it unites the omnivorous voracity and size of the pike with the defensive armature of the common perch. Such a formidable creature might work irremediable havoc if it became established in waters tenanted by other game fish.

The zander is remarkable from the degree in which external conditions and common habit have prevailed to modify its appearance to that of the pike, a fish-creature belonging to a family far lower in the scale of bony fishes. Retaining the spiny dorsal fin of the perch, its body has become elongated, and the skin closely assimilated in colour and markings to the dappled livery of the pike. The zander has its close counterpart in the New World in the American pike-perch, which has been taken weighing upwards of 40 lb.

And now, having obtained a general, if somewhat superficial, view of the ramifications of the great family of perches, it is time to devote attention to consideration of the ^{Outward appearance of the Perch.} chief of the clan in the British Isles. In appearance, courage, and esculent properties, the common perch is not unworthy of its exalted rank, besides which it attains a very respectable size. In truth, this fish, when in good condition—say from the beginning of July to the end of January—is an exceedingly comely creature, well deserving Pope's encomium—

The bright-eyed perch with fins of Tyrian dye.

If it has not the lustre and symmetry of a new-run salmon, nor the jewelled sparkle and iridescent hues of the best type of brook-trout in its prime, it possesses an aspect of vigour which is very prepossessing. We all know what a difference

"carriage" makes between two men of equal stature, or even in the same man at different periods. Take an awkward ploughboy or slouching "cab-runner," and make him enlist, say, in the Grenadier Guards. After six months or a year it is difficult to recognise the same individual in the erect, well-poised, smart-mannered soldier which has been wrought out of the raw material. Well, it is the same among fish. Such creatures as chub and flounders never seem able to do themselves justice. The chub shines and the flounder displays beautiful half-tones of colour; but they are always clumsy, awkward creatures, and the angler who takes them derives small satisfaction from contemplating the contents of his basket. It is far otherwise with the perch. Living, he always makes the most of himself; dead, he becomes what the Scottish nurse consoled her dying patient by assuring him he would make—"a beautiful corpse." At his worst, the perch never assumes that lankiness which disfigures some sporting fish when out of condition. The peculiar arched or "hogged" contour of his back preserves him from that, and this also serves to balance the size of the head and mouth, which are otherwise rather too large for perfect symmetry.

Yet if the perch cannot be considered graceful, it must be pronounced well proportioned, the size and position of the different external organs being in remarkable relation to each other. The head, from tip of snout to posterior angle of operculum or gill-cover, almost exactly equals the greatest depth of body between back and belly, and the same measurement applies to the distance from tip of snout to commencement of the foremost dorsal fin, to the base of that fin, to the spread of the tail or caudal fin from point to point, and to the interval between the posterior ray of the ventral fin and the anterior ray of the anal fin. The back rises steeply from the head to the commencement of the dorsal fin, whence it slopes gently to the tail, whereof the fleshy part is very slender and mobile.

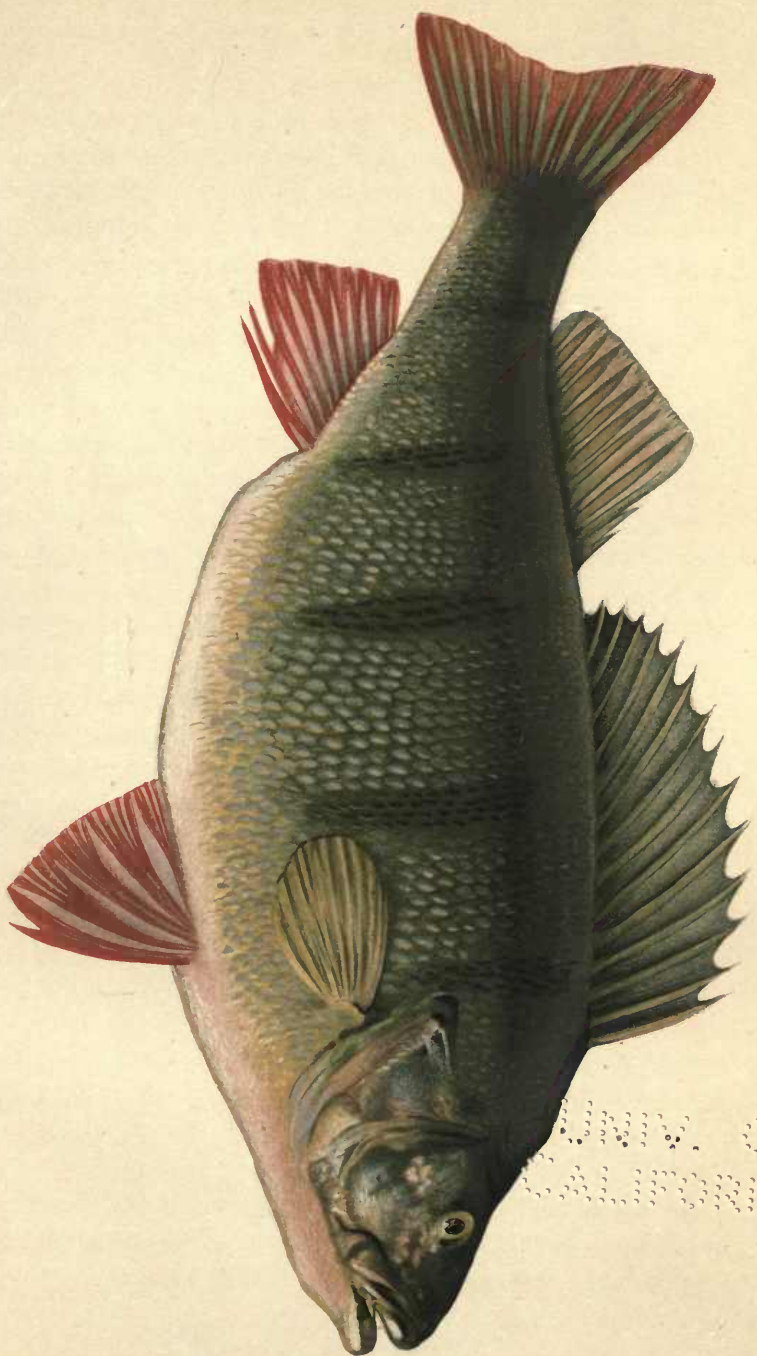


PLATE 10

THE PERCH (*Perca fluviatilis*)

Photo by J. W. Zschenedarf Esq.

$\frac{1}{2}$ Natural Size



The scales are large and distinctly marked, numbering from sixty to sixty-eight along the lateral line. They are finely serrated on the free edge, causing the fish to feel rough to the touch, and are moderately covered with mucus. The colouring of the body and fins is exceedingly rich and harmonious, quite unlike that of any other British fresh-water fish. The tint of the back is dark olive green, tending to blue in some waters and to brown in others, especially in large specimens. On the sides this ground tint becomes lighter, blending into golden yellow, and ceasing abruptly where it meets the pearly white of the belly. The forepart of the head is greenish or bluish brown; the cheeks and gill-covers display various shades of bronze, with an occasional gleam of tin, and the irides are brown. All this would make up but a sober livery compared with the metallic and prismatic lustre of some other fish, were it not for the contrast imparted by the aforesaid dark bands, which run from five to nine in number in vertical parallel stripes. These bars, combined with the gay tint of some of the fins, force the effect of the whole into brilliancy. There is no distinct outward indication of sex, although it is said that the male may be identified by his figure, which is shorter and thicker than that of the female.

Exceedingly conspicuous are the fins, eight in number. The foremost dorsal fin is an imposing object, carried boldly erect, supported by from thirteen to fifteen stiff, sharply-pointed, bony rays, which no doubt serve as a partial protection against pike, for the perch is the only British fish, except the eel, which manages to hold its own in enclosed waters infested by these marauders. The membrane is of a dull grey hue, tending to violet, except that portion of it which is supported by the three posterior rays, which is always deep black.

The second or posterior dorsal fin has fifteen or sixteen rays, all soft and without sharp points, except the foremost and shortest, which is sharp. The membrane of this fin is

yellowish along the base, blending into green and red towards the margin ; that of the pectoral fins or balancers is very thin, semi-transparent, and varies in hue from pale brown to yellowish. All the other fins—the two ventral, the anal, and the caudal—are of a lively vermilion, sometimes tending to orange, in charming contrast with the bronzy tones of the body and gleaming white of the belly.

The average size of perch varies much in different waters, depending upon the abundance of food. The rate of growth

Size. is probably slow under all conditions ; Kröyer says that at three years old the perch measures six inches in length and weighs three ounces, and that in its sixth year it is sixteen inches long and weighs a pound and a half. This may be the normal rate of increase, but it is certainly liable to be retarded by scanty diet, if not by narrow quarters, and might probably be accelerated if these conditions were reversed. As a young fellow, I used to work much with aquaria. Among my favourites were a dozen or so of perch, which, when caught, were from an inch to an inch and a half long. Owing to the interruption of school-times these were not fed with the regularity to which they were entitled, and at the end of two years I could detect very little increase in their stature. No doubt, had they been at liberty, roaming over a water-bottom teeming with life, they would have fed incessantly and increased in due proportion.

In waters favourable to their development, perch of from 1 lb. to 3 lb. in weight are taken not infrequently, and the persevering angler is entitled to expect one occasionally of even greater size. Every writer who has dealt with this fish for the last century and a half has quoted Pennant's report of a perch weighing 9 lb., said to have been taken in the Serpentine. Pennant was a good naturalist, no doubt ; but he was even more renowned as a traveller, whose business it was to make his tales readable. He may have refrained, therefore, from making due allowance for that remarkable property in sporting

fish which causes them to increase continuously in weight after death. The heaviest perch recorded, upon explicit and trustworthy testimony, as having been taken in British waters, is that which Montagu, a trustworthy naturalist, affirms that he *saw* taken on a night-line in the Wiltshire Avon, weighing 8 lb. Next comes Colonel Thornton, of Thornville Royal, in Yorkshire, who in 1784 made a sporting tour through Scotland as far as Strathspey. He took with him a regular camp train and equipage, just as any enterprising young man might do at the present day for an expedition to Africa or the Rockies. The gallant colonel shot and fished freely wherever he went, and published his experiences in a most entertaining book, entitled *A Sporting Tour through the Northern Parts of England and great part of the Highlands of Scotland*.* He describes his capture on a spinning bait of a perch in Loch Lomond weighing 7 lb., and there is no reason to suspect him of exaggeration in this matter, for his narrative throughout bears the stamp of truth. In his following was the well-known animal painter Garrard, whose brush, it is to be deplored, was not employed in portraying this noble fish, as it afterwards was in painting the picture of the great pike of Loch Alvie, also killed by Colonel Thornton, which now hangs in the saloon of the Piscatorial Society in the Holborn Restaurant.

Over certain other records of heavy perch there hangs a cloud of uncertainty, if not of suspicion. The bass, or sea-perch (*Labrax lupus*), whereof further mention will be made presently, indulges an inclination to ascend tidal rivers. It is a near relative of the common perch, and it has been surmised by Mr. Alfred Jardine, an experienced authority upon pike and perch fishing, that most of these monsters may be identified with the bass. Indeed, one so-called perch, weighing $10\frac{1}{4}$ lb., was sent by the Birmingham and Midland Piscatorial Association to the International Fisheries Exhibition in 1883, and was proved upon examination to be a bass, or sea-perch.

* London, 1804; second edition, 1896.

The spines of the dorsal fin had been tampered with, and dark stripes painted on the body, which certainly justified the committee in rejecting this exhibit as a fraud.

A perch of 8 lb. taken in Dagenham Breach, Essex, and one of 7 lb. reported from the New Cut between Readham and Herringfleet, both many years ago, may be accounted for as cases of mistaken identity ; as may probably one killed in the Lunan, Forfarshire, in 1894, weighing 5 lb. 13 oz. The late Frank Buckland vouched for three genuine fresh-water perch, two of $4\frac{1}{2}$ lb. each, taken respectively in Wroxham Broad and in the Bure ; and the third of $4\frac{3}{4}$ lb., caught in the reservoir at Daventry. But the three largest specimens which have fallen to the rod of Mr. Jardine, who has probably killed more perch than any other living angler, weighed respectively $3\frac{1}{2}$ lb., $3\frac{1}{8}$ lb., and 2 lb. 15 oz., all taken in the Colne and Loddon. The present writer, although as a boy he killed many hundreds of perch in Scottish waters, never scored one of 3 lb., although twice he has come within three or four ounces of that weight, and many times has caught perch weighing over 2 lb.

Perch are essentially gregarious fish, swimming and seeking their prey in shoals, which are sometimes exceedingly numerous.

Habits. Usually the members of a shoal are of nearly uniform size, the more numerous the shoal the smaller the fish.

It may happen to one idling motionless beside a placid bay of some clear lake to behold a beautiful sight. A multitude of little forms, all striped alike, and about four or five inches long, glide in gently from the deep water over the sand and pebbles, threading their devious way among the stems of water-weeds. Here, half a dozen or so break away in pursuit of some *gammarus* or swimming larva ; there, a floating fly tempts one of them to dimple the surface in a leisurely fashion, very different from the upward rush and dash of a lake-trout. But these always rejoin the company ; never resting, never rapid, except in pursuit or alarm—these little fellows, to the

number, it may be, of fifty, it may be a hundred, continue the general forward movement. One would say that they gleaned every edible thing as they went, but no sooner are they off the scene than another band succeeds, less numerous but larger individually, and these, too, find much that is worth picking up. They also pass on their way, comely fellows of from half a pound to a pound in weight; and next, if you are lucky, you may detect a pair of patriarchs sailing slowing in. Great perch seem to dispense with the gregarious habit, but I am inclined to attribute this less to the exercise of choice than to the force of circumstances. It seems likely that the shoal originally consists, if not of the offspring of one pair of parents, at least of young things from a common nursing ground. Instinctively they herd together; casualties, to which subaqueous life is peculiarly prone, thin their ranks, until, after four or five years, of the myriad fry which set out together upon the voyage of life, only a few individuals, it may be but two or three, survive to cruise over the old playground, and, it must be confessed, to levy shameful toll upon the rising generation of their own kind. Like most predatory fish, big perch are not scrupulous in the matter of cannibalism, and it often happens that the body of a niece or grandchild, laid upon a night-line to lure a pike to his doom, proves fatally irresistible to the appetite of a wicked uncle or gluttonous grandsire.

These observations apply more directly to the habits of the perch in lakes, where this fish occurs in larger numbers than in rivers. Indeed, despite the specific name of *fluviatilis*—river-haunting—conferred upon the perch by Linnæus, this fish must be regarded as more at home in still water than in streams. At all events, its natural habits are more fully developed in the former than they can be in the latter. In rivers the perch finds comfort only in still and deep reaches and backwaters; floods interfere with its gregarious inclination and break up the great shoals into little companies; it is never

found in such trifling becks and rivulets as serve to shelter a true riverine fish like the trout. In fact, if you want to define the true *home* of any animal, find out where that animal is reared. The true home of the eel is in the sea, for it is in the sea that the young eels are hatched ; that of the salmon is running fresh water, for there alone can it reproduce its species. The true home, therefore, of the perch being still water, it is only in a wide expanse of the same that you can observe the natural habits of that fish. In no river, probably, could the performance be equalled which is recorded by the Rev. Richard Lubbock, namely, the capture of eighteen perch, in one of the Norfolk Broads, at a single fishing, and without moving the punt, not one of which weighed less than two pounds.*

The perch can only spawn in still water, or in a very gentle current. The operation takes place in the spring months, varying, according to latitude and temperature, from March to the end of May. I have never witnessed the process, but it has been described as being effected by the female rubbing herself against stones, stakes, or water-weeds. The eggs as they leave her body receive a coating of mucus, and form a tangled skein, sometimes five or six feet in length. The late Mr. Francis Francis, a well-known writer upon angling, compared these eggs in appearance to ropes of tiny seed pearls.

Nature—that vague abstraction whereof the designing power is manifest everywhere, and which we dimly personify in our imagination—Nature, I say, adapts all her means to one supreme end—reproduction. Provided this be secured, and thereby the perpetuation of the species be maintained, she shows herself absolutely indifferent to the fortune or fate of individuals. Life, which we have installed in our ethical system as a sacred thing, not to be wantonly wasted, she casts about sometimes

* *Observations on the Fauna of Norfolk*, by the Rev. Richard Lubbock. Norwich, 1845.

in most spendthrift fashion, creating living organisms whereof not one in a hundred, it may be not one in a thousand, have the most infinitesimal prospect of attaining maturity. At other times she treats the vital principle as a rare treasure, hedging the embryo with elaborate defence, and providing infinite protection for the young creature. The same want of principle, as we may call it in a Pickwickian sense, is apparent in all living things, animal and vegetable. The end is everything ; the means indifferent. Thus the oak produces comparatively few acorns, each enclosed in a horny sheath to protect it from injury ; while the fig-tree contains in each single fruit more living seeds than are borne by a large oak. Mammals which undergo long and laborious gestation are endowed either with high intelligence to provide for their offspring, as is the case with man, or with formidable strength, like the elephant. In no class of animals are these extremes more manifest than in fish. The sharks and rays, fish of a very primitive type which existed many ages before the modern bony fishes which we are considering had been evolved, lay few and large eggs. Some species may possibly be viviparous, that is, their young are produced alive, thereby escaping all the perils incident to eggs and tender alevins abandoned to chance ; but most of the sharks produce a few—very few—eggs, each of which is enclosed in a large purse or sheath of an exceedingly tough, horny substance. When the young creature is ready for a start in life, this case splits along one of its ends, and a little shark, dog-fish, or ray, already several inches long, swims abroad upon a career of destruction.

The cod, on the other hand, affords an instance of the opposite extreme. A single large female may deposit as many as nine million eggs, every one of which is the germ of a potential twenty-pounder. Yet neither sharks nor cod increase perceptibly in numbers. By severe economy of the principle of life in one case, by reckless disdain for it on the

other, Nature effects that both these fish shall hold its place in the population of the sea—hold it, and no more.

The reproduction of the perch is conducted on the spend-thrift or broadcast system. It is usually calculated that a female perch of half a pound in weight contains upwards of a quarter of a million eggs, while Picot, of Geneva, reported that the ovary of a single female weighing one pound contained no less than 992,000. At this rate, the crop of spawn in a single season from a shoal of perch suggests an amazingly rapid increase in the species ; but such is the avidity of water-fowl, water-insects, and fish of other species for this gratuitous supply of food, that only a small percentage of the eggs ever reach the hatching point. Even so, towards the end of summer countless numbers of perch fry may be seen swarming in quiet corners and shallow bays ; and these, again, have to run the gauntlet of innumerable foes, including, as mentioned above, their own blood relations.

While on the subject of perch fry, I may put on record an incident which, occurring many autumns ago, set at rest for ever, so far as I, at least, was concerned, the vexed The hearing of fish. problem whether fish can hear. The fact that fish possess ears might be assumed as an answer to the question, but the additional facts that they possess no external ear-covers, and that the skin covers the opening to the auditory chamber, are quite enough to account for the prevalent belief that fish have no ears, and therefore cannot hear. The fry of perch were the means by which I received ocular demonstration to the contrary.

In still, bright October weather I had set up my easel on the shore of Loch Ken, in Galloway. The water was calm and very clear, and as I was painting I noticed that near the margin it was peopled by multitudes of tiny perch. Towards the afternoon a party of partridge-shooters appeared in a turnip field fully three-quarters of a mile from where I was sitting. Presently one of them fired a shot. The report came clearly,

because of the stillness of the air, but at that distance it could not be called loud ; yet the shoal of fry instantly darted into the deeper water. In a little while they began to creep back towards the shore, where minute delicacies most abounded. Then came another shot—off again went the fry ; and so after every shot, repeating the performance for my edification eight or nine times. There could not be the slightest doubt that these inexperienced little creatures felt alarmed and fled for shelter at the unaccustomed noise ; but it is difficult to understand why such a comparatively feeble sound should have frightened them. The Helmsdale is a salmon river which I have visited each spring for several years past. The Highland Railway follows the course of the stream, and at certain places runs close beside it. I have felt the earth tremble, and the whole valley fill with dreadful noise, as a heavy train roared close alongside the pool in which I have been fishing ; yet it is no uncommon experience to hook and kill a fresh-run salmon immediately after a train has passed. In short, the din and the violent vibration seem to have no alarming effect at all upon the fish, although to a salmon which had left the silent ocean depths but a few hours before, one would expect that the sound would prove as startling as it was novel.

Considered as a sporting fish, the perch possesses that quality which adds incalculably to the excitement of pursuit
Perch as food. and the gratification of the captor—it is excellent as food. This may seem but a sordid consideration, yet it is one inseparable from most field sports. We hunt the fox, though when we catch him we can make no use of him at all ; but we often get plenty of fun out of “Charlie,” although he may live to run another day. If the sport of fox-hunting is to continue, foxes must first of all be preserved, or they would soon be exterminated as completely as wolves have been in Britain, and for the same reason, that they were destructive beasts of prey. They must next be killed in moderate numbers, or the country would become overrun with them. But nobody

feels when the hounds run into a fox that a valuable prize has been secured. The killing is an incident, more or less disagreeable ; and it may safely be said that, were the flesh of pheasants and grouse no more palatable and nutritious than that of a fox, the inducement to make big bags would cease. Were mere killing for the sake of killing the motive of sport, what would become more popular than rat-hunting ? The perch, therefore, has this merit above other fish in the angler's esteem, that it is really excellent on the table. Cooks dislike the perch, perhaps, because it is a troublesome fish to prepare, having rough scales which must be scraped off, as a preliminary to most methods of cooking ; but speaking as one who is exempt from that irksome task, and whose function it is to pronounce upon fish as a dish, I give the palm to the perch among British fresh-water fish, always excepting the salmon. There be many who will deem this an unmerited slight upon the trout. Well, it is a matter of taste ; personally I prefer perch, unless it be very small Scottish burn-trout, whereof I lately devoured five at a sitting and wished for more. Clean, firm, and white, destitute of that insidious earthy flavour to which fresh-water fish are so prone, the flesh of a well-nourished perch taken in pure water any time between the middle of June and the end of February is equal to all but the best of haddocks.

We Britishers are a spoilt race : we ransack the earth for our ordinary food, as well as for delicacies ; but we are wont to neglect the abundance at our doors. Given our climate and fresh-water area, in almost any continental country the rearing, fattening, and capture of perch for the market would be a regular industry ; but in these islands we never trouble our heads about them. I happen to live on the shores of a wide, shallow bay, a kind of backwater of the strong tides in St. George's Channel. Into this quiet retreat shoals of cod drop back after spawning, and thousands are caught and sold—soft, watery, insipid creatures. By the time they are getting to be worth attention they are off into the strong water again.

People are content to eat these creatures in an unseasonable condition, because they know that cod is a regular article of merchandise and food ; but of the perch which swarm in the neighbouring lakes, few have ever taken so much as a sample. Only a few cottagers use them when their boys spend a summer evening pulling these fine fish out with an ashen stick, a few yards of coarse twine, a cork, and a hook concealed in the carcase of an earthworm. Yet hath so shrewd a philosopher as Sir Thomas Browne, author of *Religio Medici* (1635), declared that perch taken in Breedon Broad, in Norfolk, where the salt water mingles with the fresh, “make a dish very dainty, and scarce to be bettered in England.”

Whole chapters might be devoted to deploring the heartless indifference our people show in the preparation of food for the table. Our neighbours across Dover Straits understand thoroughly how much the pleasure of living is enhanced by skilful cookery. I have eaten a kelt salmon at Amiens with relish, so wondrously had it been manipulated and *revived* by scientific treatment ; and as for a certain *fritûre* of tench which I once had served to me in a humble wayside tavern at Meung-sur-Loire—*voilà des années*—why, it lives as a landmark in my gastronomic experience. Yet either kelt salmon or tench, served up with the appalling frankness with which the ordinary English “plain cook” deals with fish, were enough to daunt the finest appetite. Perch may be served

How to cook Perch. in many excellent fashions—grilled like a haddock, floating in *souchet* (I have qualms about the spelling), fried in fillets with egg and breadcrumbs, stuffed and baked, stewed *en bécasse* like a red mullet—but perhaps in no form is it better than when spatchcocked and broiled in butter, or the finest Lucca oil. The late Mr. Francis Francis, hardly inferior in critical gastronomy to skill in angling, used to pronounce the following to be the *ne plus ultra* of cooking a perch :—

“First catch your fish—then kill it. Wipe it with a damp towel, and then, *as it is*, with inside intact, and head,

gills, and scales remaining, broil it over a clear fire quickly. It will come to table seething and smoking. Insert a knife behind the head, and the scales, like a suit of armour, will come off. A little butter, pepper, and salt complete the preparation, and the flesh may be flaked from the bones—firm, white, and of most delicious flavour.”

To this it is expedient to add the following warning : that, to be cooked in this way the fish must have been but a few hours at most out of the water, otherwise decomposition of the contents of the stomach and bowels will engender unpleasant consequences.

Russian markets deal with large consignments of perch—fresh, frozen, salted, and dried—and these form an important part of the food supply of the country. Except as food, the only economic use to which perch are put in that or any other country is in the manufacture of isinglass, from the dried skins.

British anglers are accustomed to classify the fresh-water fish of their country somewhat roughly as “sporting fish” and “coarse fish.” In the first of these classes are included only fish of the salmon kind, viz., salmon and salmon-trout, river- and lake-trout, and grayling. At the head of the second class it is the custom to place the pike, in virtue of the great size to which that fish sometimes runs ; were it not for that, undoubtedly the highest rank would be assigned to the perch. This fish possesses that degree of voracity which is essential to the angler’s success in luring it to the hook. Small fish, worms, floating flies, water insects, and larvæ are all in their turn part of its staple diet, and it is very bold in pursuit of them. But, like all fish, the perch is subject to capricious periods of abstinence, when it refuses all food, even in the midst of abundance and variety. From this apparent caprice arises one of the most powerful attractions of angling—its uncertainty. Nobody can foretell with confidence the behaviour of fish at the beginning of any given day. They

may be inclined to dash at the first bait offered to them, or they may sullenly decline the most seductive delicacies dangled before their noses. This irregularity of conduct is usually explained to be the result of electrical conditions of the atmosphere, whereof man is insensible, but to which the organism of fish respond in some peculiar way. The explanation is too vague to be scientific or satisfactory. Have not all fishermen experienced disappointment on what appeared to be an excellent fishing day? And, on the other hand, have they not scored occasional success under conditions of weather most forbidding? I may mention in reference to this a suggestive incident which came under my notice some years ago illustrating, though far from explaining, the unaccountable behaviour of fish at uncertain times. It happened in Naples, one morning in January. Mount Vesuvius was capped with snow; at the sea-level the temperature was coldish, yet not so cold as to prevent me sitting for some time in the sunshine in the gardens of the Villa Nazionale. I then visited Dr. Döhrn in his magnificent Marine Biological Station, and finding that the fish and other animals were just about to be fed, I accompanied him and the feeder in their round of the tanks. All the creatures showed eagerness for their meal, until we came to a tank containing dog-fish—of all aquatic creatures most indiscriminately voracious. Much to my surprise they were motionless—curled up together in torpid squads at the bottom of the water. “No use giving *them* anything to-day,” quoth Dr. Döhrn, and, on my expressing surprise that they should be left fasting, he explained that at certain times these fish refused all food, and assumed this semi-torpid state, indifferent to anything that might be offered to them. He considered it probable that this was the result of certain meteorological conditions, which, though imperceptible to ourselves, affected the organism of these fishes in a manner unfavourable to activity. Herein, methought, lies the secret, could we but unravel it, of many an unprofitable day’s fishing at home.

Perch are at times so hungry and unsuspecting as to allow themselves to be caught in scores by means of the rudest tackle. I happen to possess within my park a natural lake of about one hundred acres, wherein perch and pike do greatly abound. The fishing is free—that is, leave to fish is never refused to any respectable angler ; the more they catch, the better I am pleased. What does vex me is that some people consider it unnecessary to bring a rod with them, but supply themselves instead with an ash sapling cut for the occasion from the neighbouring woods. Forasmuch as the straightest and cleanest-grown sapling makes the shapeliest rod, the result is that I have to pay for this kind of depredation by the loss annually of some of the most promising young trees. Howbeit, having cut many a rod in the selfsame woods when I was a boy, I have not the heart to adopt rigorous measures against this manner of pilfering.

What rapture I used to experience in those far-off summer evenings when the water lay dark and tranquil in the reed-fringed bays ! The rod of green ash had been prepared by pruning off the leaves and branchlets ; a piece of strong twine the same length as the rod served as a line, to which was attached a hook on a single strand of gut. A piece of ordinary bottle-cork, cut halfway through and bound with thread, made a float, and with what Izaak Walton commends as “a lively, quick, stirring worm” as a bait, the equipment was complete. Then off we glided in the slow, tarry tub of a boat, to some bay of high repute, where the trees already cut off the westering sun. What tremulous fingers moored the rickety old craft to the mossy piles ; with what expectation was the bait and cork dropped into the water, clear with the mysterious and uncertain translucency of black glass ! Then what a period of suspense ensued ! If there proved to be one perch in that bay, assuredly there would be a shoal ; but sometimes the precious evening hours ebbed away while we probed one bay after another without finding the denizens desired. Generally

there was no need to wait long. On a July evening such as this, with a clear sky overhead and the sun behind the trees, if there were fish in the quarter they would not refuse to do business.

The cork floats motionless at first, then behold ! it begins to twinkle, sending tiny, circular ripples across the surface. "Yonder him !" cries the old gamekeeper, whom the boy beside him regards as omniscient in all things pertaining to the craft of fishing and obeys his lightest word. "Yonder him ! canny noo ! Canny ! bide still a wee, till he gets it in his thrapple." The young angler complies with the utmost difficulty, his little arms twitching with eagerness to tighten on his prey. The twinkling of the cork ceases—the fish has gone ! No, it twinkles again, then bobs, and twinkles again. Now it begins to slide through the water, still twinkling, sinking deeper, until—oh, moment of ecstasy !—it goes under altogether and is seen getting dimmer in the depths. "Out wi' him noo !" cries the Mentor, and immediately the pupil exerts all his strength ; it is well it is not greater, else *something* must give way. After a struggle of a second or two, up flies into the air a perch of three-quarters of a pound, and by the elder angler's directing hand is brought safely into the boat. What a beauty ! How rich the velvety green of back and sides, set off by symmetrical darker stripes ! How brilliant shine the carmine fins against the pearl-white belly ! Woe is me ! Why is it that as one approaches maturity, or, if candour be the order of the day, at a period considerably on the wrong side of maturity, one cannot view such a fish with the same rapturous admiration that stirred the lad of less than a dozen summers ? Why does the first twinkle of the floating cork no longer set his pulses flying and his heart beating to the same wild measure that once thrilled him through and through ? Why, in short, does one grow old and cold, and, straining to the last after the unattainable, cease to prize that which once composed unspeakable delight ? At all events memory is a blessed possession, and one still has the

power of drawing tranquil pleasure from scenes which once filled him with excitement so exquisite as almost to amount to pain.

One tragic incident of an early perch-fishing expedition comes to mind, teaching the lesson of care in the handling of instruments of the chase, and that all is not fish that may come to the hook. The morning had been bright and breezy ; the game was not on the feed, wherefore the simple rods and tackle were laid against the wall of a farm-garth, to be resumed towards evening, and the anglers turned to discuss the contents of a comfortable luncheon basket. Other bipeds were abroad seeking their meat. Poultry went about the farm ; a worm remained on the hook, whence it came to pass that, when the young fisher went to resume his gear, worm and hook had both found their billet far down the gullet of a lively hen. Poor Partlet was struggling vigorously at the end of a tight line, and—— But let oblivion drop its kindly veil over the harrowing scene which followed. The serenity of the evening's sport was irremediably marred.

By such simple appliances as I have described and other favouring conditions of water and weather, it is often but a question of perseverance how many perch one may choose to catch.

The late Professor Romanes estimated the average intelligence of fishes as equal to no more than that of ants, or of children four months old. Nevertheless, the angler knows that fish possess enough wits to profit by experience ; and it cannot be doubted that, in waters that are much fished, perch become worldly-wise and suspicious, requiring to be circumvented by less conspicuous machinery than serves to take them in some Scottish loch or English preserve. Adepts recommend a light cane rod, twelve or thirteen feet long, a Nottingham winch or reel, a delicate running line of silk, and a contrivance which, for some inscrutable reason, is termed a paternoster. This is a device, as Izaak

Walton remarked of a fishing reel, which he had never seen, and as lesser men might observe of ghosts or ping-pong, or ~~The Pater-~~ a fashionable lady's hat, which "is to be observed ~~noster.~~ better by seeing one of them than by a large demonstration of words." To the running line is attached a gut trace about four feet long, with a small leaden plummet at the end thereof, and to this trace are looped at intervals three pieces of fine salmon gut five inches long, each armed with a hook. The uppermost hook is generally baited with a live minnow, the two lower ones with choice earthworms. The paternoster is used without a float; the plummet is dropped into those parts of the water which experience points to as the likeliest haunts for perch—hollow banks, tree roots, piles, camp-sheating by locks and weirs, and, in lakes, especially along the margins of beds of that dark green, round-stemmed rush which some people call bulrush, while others apply that name to the reed-mace. One place after another should be tried; the presence of feeding fish is signified by a sharp tug on the line, which should be kept moderately taut; where one fish is, good sport may be expected, for perch are seldom solitary swimmers.

The paternoster, however, is an elaborate artifice which is seldom resorted to except in the neighbourhood of large towns, ~~Float-fish-~~ where fish have become scarce and wary. ~~ing.~~ Nine anglers out of ten content themselves with a float and a single hook, baited with a worm or small live fish. Floats are of many varieties, from the homely cork to the delicately fashioned quill; but they fall under two principal kinds—the stationary float, for fishing in still water, and the travelling float, for streams into which a skilful Nottingham angler will search the ground to a distance of seventy or eighty yards below where he stands.

Perch may be taken by the spinning bait, but inasmuch as they swim in shoals, confined to a limited extent of water, the live bait is found a more profitable means of capture. They also take the artificial fly, but this is only exceptionally successful.

It would not repay anybody's trouble to go fly-fishing for perch, seeing that the fish swim so deep as a rule. The best chance is in hot weather, when perch sometimes resort to the shallows. A red spinner or small Alexandra will then allure them readily enough; and it is a pretty thing to see two or three striped fellows racing after the fly. But they do not make a dash and quick turn at it, after the manner of the trout; and, on the whole, the perch may be pronounced distinctly the prize of the bottom-fisher.

Spinning
and fly-
fishing.

The Bass, or Sea-Perch (*Labrax lupus*)

FIN FORMULA.

First Dorsal: 8 or 9 spines.

Second Dorsal: 2 or 3 spines, 9 to 11 rays.

Pectoral: 16 rays.

Ventral: 1 spine, 5 rays.

Anal: 2 spines, 9 or 10 rays.

Caudal: 17 rays.

TEETH.

All villiform, without canines; on the palatal bones, vomer, and tongue.

Of the bass I cannot speak from personal observation, having never had opportunity either of watching it in its native haunts or of angling for it. Indeed, I feel some doubt as to the propriety of including it among fresh-water fishes, seeing that it is essentially a marine species, and although it frequently enters rivers, I am informed that it is seldom found above the tidal waters. Nevertheless, high spring tides carry this fish at times far into the domain of the landsman angler, affording sport under such conditions in the Arun, for instance, a clear mile above Arundel. Ancient and modern writers agree in recommending that bass should be kept in fresh-water ponds to be fattened on a liberal diet for a month or six weeks before it is killed for the kitchen. Yarrell speaks of one Mr. Arnold who used to keep these fish in a lake in Guernsey.

The name "bass" seems to be but a variant of "barse,"

the East Anglian term for the common perch ; for, as Professor Skeat has pointed out, the English fashion of slurring the *r* renders the presence of that consonant of uncertain significance except at the beginning of a syllable.

In external form the bass, or sea-perch, differs from the river perch chiefly in having only nine spines in the dorsal fin instead of thirteen to fifteen, and in carrying teeth upon its tongue, whereas the tongue of the river perch is unarmed ; but its scheme of coloration is very different. The bass has discarded or concealed the parti-coloured attire which distinguishes most of the perch clan, and has assumed a salmon-like livery, grey on the back and bright silver on the sides.

This fish appears in shoals in the shallow seas and estuaries of Southern England and Ireland from about the middle of June to the middle of September, but in the more northern parts of the British seas, bass are seldom taken. One, however, was killed on a salmon fly in the tidal water of the Arbort river, on the west coast of Inverness-shire, July 16th, 1901, by Mr. Alexander Grant.*

The Greeks and Romans of classical times esteemed the bass very highly as a table fish, and those which entered the Tiber and gorged themselves with the refuse at the outfall of *Cloaca maxima* were esteemed the finest for this purpose. At the present day this fish has fallen out of repute as a delicacy, and even as food ; few people, probably, being qualified to testify from experience as to its merits.

Anglers who have encountered this voracious fish speak highly of its sporting qualities ; but opportunity seems to be ^{Angling for} even more fickle in its favours to bass-fishers than ^{Bass.} to others. Mr. Aflalo, in his recent work on *Sea and Coast Fishing*,† dilates enthusiastically upon them as the most sporting fish to be caught in salt or brackish water ;

* Mr. Harvie Brown, in *Annals of Scottish Natural History* (No. 43, p. 155).

† London : Grant Richards, 1901.

but even he does not seem to have scored any marked success with them, and the blanks evidently have outnumbered the prizes in the same proportion as in most lotteries. Mr. Jardine, on the other hand, describes bass of from 8 lb. to 10 lb. as "not by any means uncommon captures," and notes that the largest he ever caught was taken by spinning bait off Brixham, in Devon, and weighed $13\frac{1}{2}$ lb.*

He cites Frank Buckland as recording one of 22 lb. from Herne Bay, and Yarrell one of 28 lb. Some notable captures have been reported while these chapters were being prepared for the press. In September, 1902, a large number of bass were observed in the deep reaches of the Tamar, whence they dropped down with the tide to the junction of that river with the Tavy. Numbers of anglers plied these fish with every kind of bait, but in vain. Sam Brown, however, a Saltash fisherman, succeeded in taking a huge fellow in a stop net, weighing 22 lb. 2 oz. On November 2nd of the same year a bass of $15\frac{1}{2}$ lb. was found stranded on the rocks at Ramsgate.

Bass are sometimes taken by the rod off piers, such as that at Littlehampton and Exmouth, which are favourably placed in the estuaries of rivers frequented by these fish, the tackle usually most successful being a short nine-foot rod, a Nottingham reel with a hundred yards of the fine, strong silk line used in tarpon fishing, a trace of treble twisted salmon gut, a pike-float, and a very large hook baited liberally with soft green crab. For fishing at sea a longer rod is recommended, and the favourite bait is a pilchard, or four sand-eels arranged so as to form a group on two large hooks on separate strands. Bass are also taken by spinning, and even by casting a large fly resplendent with much tinsel. But, as I have said, I have no personal acquaintance with this fish, and I shall do the reader the best service in my power by quoting from the

* *Pike and Perch*, by Alfred Jardine. The Anglers' Library. London: Lawrence & Bullen, 1898.

writings of Mr. Aflalo, who has made a special study of sea-fishing:—

“I have long thought, though it must be admitted that I can quote no successes in support of the notion, that the true secret of successful bass-fishing will be solved from a sloping beach, so often have I seen large bass after an August gale feeding just behind the rollers in the surf, where it was impossible to get at them from either boat or pier. Unfortunately, at the very season when the bass come so close in shore, the beach is crowded with holiday folk, whose immediate neighbourhood the peaceful angler shuns at any cost, even that of an empty creel. I do not, however, despair of finding one of these days, in the early morning, the right combination of bass feeding close in shore and a beach with plenty of elbow-room. So far it is a dream.” *

It behoves the angler in the moment of success to be wary in handling his captive, for the bass carries some sharp spines, and is capable of inflicting very painful stabs in its vigorous struggling.

The Ruffe, or Pope (*Acerina cernua*)

FIN FORMULA.

Dorsal: 13 to 15 spines, 12 rays.

Pectoral: 13 rays.

Ventral: 1 spine, 5 rays.

Anal: 2 spines, 5 or 6 rays.

Caudal: 17 rays.

TEETH.

All villiform, without canines; on the vomer, but none on the palatal bones and tongue.

It is one of the enigmas of evolution how it has come to pass that certain animals, obviously offshoots from a common type, should be found inhabiting the same region, feeding on the same food, and practising similar habits, and yet maintaining their generic individuality. Thus the ruffe, or pope,

* *Sea Fish*, by F. G. Aflalo. The Anglers' Library. London: Lawrence & Bullen, 1898.

resembles the common and more powerful perch in so many respects that the puzzle is how it ever became differentiated, ^{The Ruffe, or Pope} and yet continued to inhabit the same waters within ^{(*Acerina cernua*).} the narrow confines of this island. Probably the ruffe is of more northerly origin than the perch, having had its dimensions restricted by more rigorous climatic conditions, which have left a stamp upon the little creature so permanent as not yet to have yielded to more temperate surroundings. Yet if that be so, it is perplexing to note that the ruffe is not found in those parts of Great Britain where the fauna retain most traces of Arctic experience, for it is unknown in Scotland and the north of England, neither has it a home in Ireland. Yet is its range far more northerly than that of the perch, for the ruffe is not found in Southern Europe, but abounds in Scandinavia, Russia, and Siberia. In the last-named territory it attains its greatest dimensions, sometimes measuring, it is said, as much as eighteen inches in length, and weighing $1\frac{1}{2}$ lb., whereas in England it scarcely ever reaches six inches in length, and more commonly measures but three or four. The largest British specimen whereof I can find precise record was one taken near Shepperton by Mr. J. H. Keene weighing just 5 oz. May we not, then, consider the ruffe as hypothetically an Arctic perch, a survival of more severe climatic conditions than now prevail in regions which have since been colonised by the more robust genus?

In general form the ruffe bears a marked resemblance to the common perch. It has a similar hog back, carrying a spinous dorsal fin. But whereas the perch has two ^{Outward appearance.} dorsal fins, one spinous, the other soft, these are united in the ruffe, the forward portion being usually supported by fourteen sharp spinous rays, the posterior by a dozen soft rays. The præoperculum, or foremost gill-cover, differs from that of the perch in a remarkable feature, the border thereof being armed with ten or a dozen divergent spines; while the operculum, or posterior gill-cover, ends in a single

sharp spine, protected by a flap of skin. Professor Skeat pronounces the origin of the name "ruffe" to be unknown ; but I am bold enough to suggest that a closer acquaintance with the fish itself would have suggested to him the obvious inference that the name was connected with this spiny gill-cover. The earliest occurrence of the name is in the *Promptorium Parvulorum* (A.D. 1440), and it is natural to connect it with the idea of a frilled ruff, such as has been supposed to be the origin of the same name borne by the ruff bird. Otherwise, taking the prickly gill-covers together with the spiny dorsal fin, it may be that the significance was merely the "rough" fish. In fact, Gesner (1516-1565) expressly states that in England it is called the ruffe *ab asperitate dictus*—on account of its roughness. As for the synonym "pope," which, to judge from what Izaak Walton says, is the older designation, no suggestion can be offered as to its meaning.

In colour the ruffe displays none of the brilliancy in which so many of the Percidæ indulge. It is an obscure little fish, in general hue resembling the gudgeon ; it wears a jacket of lightish olive mottled with a darker tint, and with brassy tones upon the sides. The belly is white ; the throat, the anal and ventral fins being tinged with a ruddy hue. The only suggestion of the piebald decoration so characteristic of this family is furnished by dark spots on the dorsal and caudal fins. The skin secretes a copious mucous, whence the Norwegian name "snorgers"—signifying the slimy fish.

The gregarious habit is not so definite in the ruffe as it is in the perch, neither is the ruffe so active and bold as its more powerful relative. It is a predaceous fish, however, living in streams for the most part, and lying in wait for food in the more sluggish parts of them, rather than roaming in quest of prey. In diet it is far from fastidious, feeding on fish-ova, worms, insects, and probably such small fish as do not outstrip its limited powers of locomotion. It spawns at

the same time of year as the perch, the yellow eggs being woven in festoons after the manner in vogue with that fish. In short, the ruffe may be described as to character and habit as an unwarlike, mild-mannered perch. Izaak Walton vouches for its excellence on the table, declaring that "no fish that swims is of a pleasanter taste." The greater the pity, then, that there is so little flesh in the diminutive carcase.

My own experience of the pope as a sporting fish is of limited extent and of very ancient date. It used to be plentiful in the muddy waters of the canal at Leamington, near ^{Angling} ~~for Pope.~~ my old school, and gave us diversion on Saturday afternoons in far-off summers. Fine tackle, a light float, and a red worm on a small hook are pretty sure to produce samples of the ruffe in such waters as it inhabits. But in no part of Britain is the ruffe found in such numbers as in the Norfolk Broads, where anglers are often disgusted and driven to another beat by the persistent biting at the bait by shoals of these little fish, the "poor relations" of the perch, which is the coveted quarry.

The fatal consequences of inheriting a bad name are proverbial. It proved to be a cruel destiny that conferred the title of "pope" upon an inoffensive creature in Protestant England, for it has exposed it to persecution of a peculiarly barbarous and senseless kind, which, unless the influence of school boards has prevailed to suppress it, continues at the present time. Frank Buckland described how the people of Sheffield and other large towns used to go in hundreds to a place well-named Crewell Bridge, in Lincolnshire, where these fish abound. Every pope caught had a cork impaled on its dorsal spine, and was set at liberty, until the surface of the canal for miles was covered with bobbing corks. Of course all these luckless fish were doomed to a lingering death.

CHAPTER V

THE MILLER'S THUMB AND STICKLEBACKS

The Miller's Thumb—Distribution—Habits—The Three-spined Stickleback—Appearance—Habits—Distribution—The Ten-Spined Stickleback.

Eighth Sub-Order: ACANTHOPTERYGII COTTO-SCOMBRIFORMES: THE BULLHEAD AND MACKEREL-LIKE SPINY-FINNED FISHES.

HAVING disposed of the three members of the Perch Family inhabiting the fresh waters of Great Britain, we have to descend a long way in the classified scale before reaching the next fish found in our streams and lakes. This brings us to the eighth sub-order of *Acanthopterygii*, distinguished by Dr. Günther as *Cotto-scombriformes*, the bullhead and mackerel-like sub-order, which is arranged in fifteen families, embracing fish of most diverse, and often of very grotesque, aspect. The john dory, the tunny, the weever, the angler or fishing-frog, and the gurnards are among the best known members of these families, and differ from each so widely in habits and other appearance that it may puzzle the student at first to understand how they can be classed together under any "natural" system. It must be confessed that, just as the whole order of spiny-finned fishes do not form a perfectly consistent group, so this sub-order presents some puzzling anomalies. One fin at least is always spinous; but the spinous dorsal fin is not always present, and in some families the spines have become modified into tentacles, as in the hideous fishing-frog or sea-devil (*Lophius*), and even into suction discs, as in the

strange sucking-fish (*Echeneis*), which, being a shocking bad swimmer, attaches itself by this apparatus to the bodies of larger fish or to ships and boats, and thus secures a free passage from place to place.

Most of the fishes of this sub-order are exclusively marine, but the thirteenth family—*Cottidæ*, or the Gurnard Family—contains a few fresh-water species.

COTTIDÆ: THE GURNARD FAMILY

While some of the *Cottidæ* are of extravagant and complex beauty, like the gurnards, others are of ignoble and even repulsive aspect, like the father lasher. The bones of the head are more or less armed with spines, and where two dorsal fins are present, the soft posterior dorsal and the anal fins are more developed than the spinous first dorsal. All the members of this family are distinguished by disproportionately large heads, and, although amply provided with fins, they are but indifferent swimmers.

The Bullhead, or Miller's Thumb (*Cottus gobio*)

FIN FORMULA.

First Dorsal: 6 to 8 spines.

Second Dorsal: 15 to 17 rays.

Ventral: 4 rays.

Anal: 13 rays.

Caudal: 11 or 12 rays.

TEETH.

Villiform, on the jaws
and vomer. None on
the palate.

The only representative of the Gurnard Family in British fresh-waters owes its popular name of miller's thumb to its broad, depressed head, in which a fanciful resemblance has been traced to the form supposed to be imparted to the thumb of a miller by the constant use of that organ in testing the evenness of the flour as it falls from the mill spout.

There are two or more marine species of *Cottus* found on the British coasts, but there is only one fresh-water species in Europe, although two well-defined and constant varieties occur on the Continent, distinguished as ^{The Miller's Thumb} (*Cottus gobio*). *microstomus* and *ferrugineus*. With these we have no concern in this place, having to deal only with the curious little fish which is such a familiar denizen of the shallow parts of our rivers, and, indeed, of the most insignificant rivulets.

The miller's thumb is an ungainly creature. Its utmost length is about five inches ; the broadest part of its person being across the head and gills, equal to about one-fourth of the entire length of the fish. The eyes are on the top of the head, as best fitted for the ground-haunting habits of their owner, and have a greedy, sinister aspect. Each of the foremost gill-covers carries a stout spine, an armature which sometimes proves fatal to birds which try to swallow these fish, for the miller's thumb, when he finds himself in jeopardy, inflates his operculum, spreads abroad his great pectoral fins, and tries to look as terrible as possible. These same pectoral fins are no unpleasing feature, developed, as they are, into broad and rounded fans. The ventral fins are reduced to the nature of supports to the fish as it lies upon the ground. The first dorsal fin has a rounded outline supported by eight rays, and is both lower and much shorter than the second, which has about seventeen rays. The ventral fin is greatly developed, containing about thirteen rays. Altogether the miller's thumb seems more amply provided with means of propulsion and balancing than are many other fish which have more use for them.

In colour this fish is somewhat variable, but the skin, which is without scales, has a grey ground colour, tending to brown on the back spotted with darker brown. The sides are streaked or mottled with brown, and this hue sometimes extends over the belly, which is whitish. The male is generally darker

in colour than the female, and in both sexes the iris is red. The fish possesses no air-bladder, and the stomach is a capacious round sac, lined internally with a black pigment.

The species is very widely distributed, very few watersheds being without it between Britain and Siberia, France and Northern Asia, where its place is taken by other species in that region and North America. But the miller's thumb is so scarce in Irish waters that its very existence has been denied, and it has not been recorded from Spain or Greece. Personally, I have never seen this species in Scotland.

In habit, the miller's thumb is the reverse of obtrusive; its custom is to lie under a stone, with the gaping mouth ready to seize any passing insect. Izaak Walton says that

Habits. "in very hot days he will lie a long time very still, and sun himself, and will be easy to be seen upon any flat stone or gravel," which reads like a piece of genuine observation. Other writers have repeated this statement, but whether founded upon what they have seen or only upon what they have read, the present deponent sayeth not. Inasmuch as I have not happened to witness this habit in the miller's thumb, albeit I have wasted more time by the waterside than it is creditable to record, I am not qualified either to confirm or deny this behaviour of the fish in question. Usually its leading motive seems to be keeping out of sight, as if conscious of its own ugliness.

The spawning takes place early in spring, when the female deposits bunches of rosy-tinted ova in what is called by courtesy a nest, but which is nothing more than a natural depression in the sand or gravel, or one worked out by herself. Having performed this part of the domestic economy, it is said that the prolific mother retires from the nest, and leaves it to the protection of her mate, who watches it carefully for four or five weeks, and does his best to repel the attacks of

marauders. But here again I am speaking on hearsay. Until somebody has the leisure and patience, and, it may be added, the humility, to devote systematic observation to the habits of this little fish, a degree of doubt must continue to surround its life-history. Exact science now extends over so vast a field that it is only by concentrating intelligence upon specific points that any advance in knowledge can be made, and fallacies extirpated one by one. There seems, indeed, to be some need for the alleged vigilance of the male fish over his progeny; for the Rev. W. Houghton has recorded that two females which he dissected in the middle of April not only had their ovaries full of eggs, ripe for laying, but contained in their stomachs a great number of eggs, and several newly-hatched fry of their own species.

Mr. J. H. Keene, already quoted more than once as a trustworthy observer, must be credited with the destruction of one fallacy concerning the miller's thumb, which has been copied from book to book and from edition to edition of various encyclopædias without question. Alexander Wilson, the naturalist (1766-1813), alleged that the flesh of miller's thumb when boiled was red, like that of a salmon. Nothing could be simpler than to put this statement to the test, yet dozens of writers have repeated it without doing so, until Mr. Keene proved that it was without foundation by boiling the fish, and "never yet did see the slightest approach of the flesh to a pink or red hue. It remains white, like the gudgeon, so far as my experience goes."* Nevertheless, Mr. Keene speaks in high praise of this little fish as a gastronomic delicacy.

Leonard Mascall, author of a *Booke of Fishing with Hooke and Line* (1590), was an early advocate of fish-culture, and considered the miller's thumb by no means unworthy of attention.

* *The Practical Fisherman*, p. 54.

*"To breede Miller's Thumbes and Loches in Shallow Brookes
or Rivers.*

"The fish called Loches, and the other called Millers Thumbes or Culles . . . are fish holosome to be eaten of feeble persons having an ague or other sicknesse. . . . Like as there is a shallow river running from Barcamstide to Chestum and so to Chane; also by Croydon and other places, wherein they might breede of the said fish great store, if they were so given. The like river runnes in Hampeshire bysides Altum, increasing by diverse springes, and runnes shallow in many places, and by a certaine parish there called ;* the Parson thereof hath tolde me he hath had so many of the said Culles and Loches to his tithe weekly, that they have found him sufficient to eate Fridays and Saturdays, wherefor he was called the *Parson of Culles*."

In the category of sporting fish the miller's thumb can claim no place. It is true that it may easily be caught by dangling a small red worm on miniature tackle in front of its lair. The bullhead is neither fastidious nor shy, and never seems to be off its feed; but he who wishes for a dish of miller's thumbs had best take the shortest way to his object. Let him secure the assistance of a friend and repair to the nearest brook, the smaller and shallower the better. One of the pair lifts a likely stone in the channel; very likely the dark ungainly form of *Cottus* will be seen reposing beneath it. The fish will make no attempt to dart away, and may be lifted out without difficulty and consigned to a can. A still shorter and simpler method of capture is described by Aristotle, who says: "There occur in rivers certain little fish, found under stones, which some people call Cottoi. From their lying under stones people catch them by striking these stones with (other)

* Blank in original.

stones, when the fish, being stunned, fall out." From this not very delicate experiment Aristotle argues that fish can hear.

Twelfth Sub-Order: ACANTHOPTERYGII GASTROSTEIFORMES: STICKLEBACK-LIKE SPINY-FINNED FISHES.

The fish of this sub-order are distinguished by the dorsal fin resolving itself into isolated spines, and by the small mouth at the end of a snout generally more or less lengthened. It consists of but two families, the sticklebacks and the flutemouths.

FIRST FAMILY: GASTROSTEIDÆ: The Sticklebacks

Body elongated and compressed laterally. Parts of the skeleton are produced and expanded to form plates covering parts of the skin. There are no scales, and the place of the first dorsal fin is occupied by isolated spines. The ventral fins are placed on the abdomen, and contain one spine and one soft ray.

The sticklebacks consist of but a single genus, *Gastrosteus*, wherein about ten species have been recognised; but they are such variable creatures that scarcely any two ichthyologists can be got to agree as to the number of true species inhabiting British fresh waters. Some authorities put it as high as six, but Dr. Günther, who certainly is not unduly scrupulous in admitting to the dignity of species certain forms which other naturalists refuse to regard as more than varieties, holds that we have only three distinct sticklebacks—the three-spined (*Gastrosteus aculeatus*), the four-spined (*G. spinulosus*), and the ten-spined (*G. pungitius*). Of these the first-named is by far the commonest in this country, and as I am personally unacquainted with the second, I shall do no more than mention it; taking occasion to add that it is much to be desired that those who have opportunity and inclination should devote close

attention to the distribution and characteristics of our native sticklebacks.

The Three-spined Stickleback (*Gasterosteus aculeatus*)

FIN FORMULA.

First Dorsal : no membranes, 3 spines.

Second Dorsal : 10 to 12 rays.

Pectoral : 10 rays.

Anal : 1 spine, 8 or 9 rays.

Ventral : 1 spine, 1 ray.

TEETH.

Rather large, villiform, in both jaws.

The three-spined stickleback is the smallest of British fresh-water fishes, probably never exceeding three inches in length, but it makes up for its diminutive stature by exceeding abundance, and avoids insignificance by reason of its destructive habits and indomitable pugnacity.

In shape this stickleback is very graceful ; the upper and lower contours sloping symmetrically from the small mouth to the slender tail, which is set off by the brisk spring of the fan-shaped caudal fin. The pectoral fins, which appear to be the chief organs of locomotion, are set back about one-third of the entire distance between the snout and the margin of the caudal fin, and are large and fan-shaped. The soft or posterior dorsal fin balances the anal fin, and both combine to give the little creature a very smart appearance, from the foremost ray in each being nearly three times as long as the posterior ray.

The foremost or spinous dorsal fin has disappeared, and its place is occupied by three formidable curved spines, which give the fish its distinctive name. Under the skin at the back of the head, are three other spines, two with their points directed forwards and one directed backwards. The ventral fins have become purely defensive, consisting merely of a single spine and a small ray. In front of the anal fin is an isolated spine, short, stout, and sharp.



Photo by Reinhold Thiele

Life Size

THE RUFFE or POPE (*Acerina cernua*)

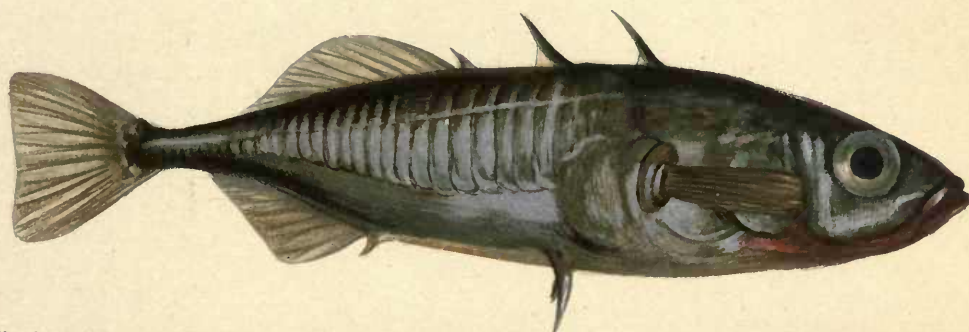
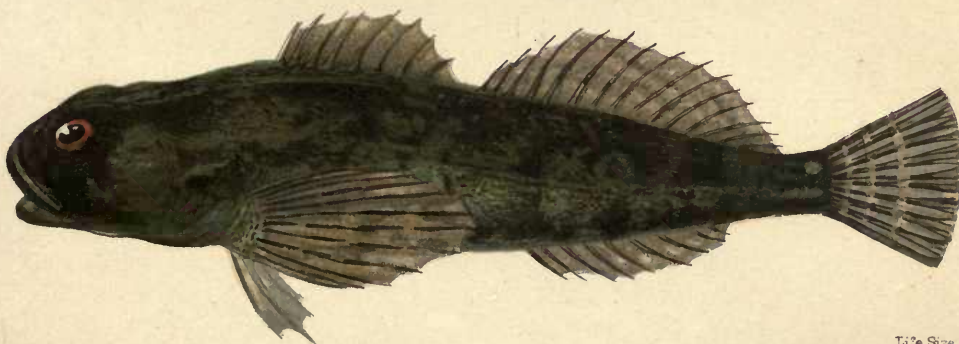


Photo by P.D. Malloch

Four times Natural Size

THE THREE SPINED STICKLEBACK (*Gasterosteus aculeatus*)



Life Size

THE BULL-HEAD or MILLER'S THUMB (*Cottus gobio*)

The skin is silvery and without scales, but certain parts of it are protected by the extension of the skeleton into bony "scutes," or armour-plating. The uncertainty which naturalists have shown in classifying the sticklebacks has arisen in great measure from the variation in this armour, which is not only sometimes absent in specimens of the three-spined stickleback from Central Europe, but changes with the seasons. Cuvier, for instance, distinguished two species—*Gastrosteus trachurus*, an armoured kind, and *G. leiurus*, a naked kind; but the Swedish ichthyologists, Fries and Eckström, satisfied themselves that these were one and the same, *G. leiurus* being the creature in his gay summer attire, when the armour is discarded, and *G. trachurus* in the more sober winter colouring, when the fish is in full defensive panoply. Moreover, they were able to show the armour in every stage of development.

The chief normal armature may be described as consisting of lateral and pelvic plates; the former protecting the pectoral region between the bony gill-covers and the pectoral fins, the latter beginning close behind the ventral fins and shielding the flank and part of the sides. The mouth of this fish is very small.

In colouring, the stickleback is as variable as in the fashion of its armour. The back may be green, brown, or slate-blue, the sides and belly are silvery. The fins are delicately tinted with green, but not so deeply as to lose their transparency. The iris is silvern, and there is generally more or less red about the throat and breast, especially in the males. It is in spring that these are to be seen in full splendour, and truly theirs is no mean glory. What the kingfisher is among British birds, the male stickleback becomes in the breeding season among the fish of our lakes and streams—a creature of tropical lustre. As he swims in the shallow water the general effect is that of fiery red and opaline green; his breast and throat are mantled with scarlet dye, and his sides shine with metallic lustre. Nor is all this fine array

put on for nothing. The courtship of fishes—of those at least with which we are most familiar in this country—is usually a cold-blooded unromantic affair. Not so the stickleback's.

Habits. Early in the year he prepares a suitable place for his establishment by clearing the neighbourhood of all possible rivals. The weaker go to the wall ; at least, they are compelled to decamp, and passengers have to prepare for battle at short notice. The challenge is devoid of formality ; the lord in possession dashes upon the stranger without any warning and attacks him tooth and nail—that is, with nimble mouth and trenchant spine. Peradventure the first owner of the coveted nook is not able to hold his own, for a chance thrust of the errant knight's spear may find a joint in the harness even of a larger and more powerful fish. Which ever wins, the meed of victory is soon apparent. The vanquished combatant fades into ashen grey, and slinks away, perhaps to die of his wounds ; but the victor, beginning to glow with brighter hues and to shine with clearer lustre, seeks the legitimate reward of valour in the favours of the fair sex. Many naturalists have described the strange and fascinating little drama which ensues, and which may be witnessed, it is said, by anybody who will be at the pains to keep sticklebacks in a suitable aquarium. The victorious male sets about constructing a nest. First he forms a depression in the sand by rolling his prickly body about therein ; then he collects delicate vegetable fibres, such as stems of water-weeds or grass, rootlets, and so on, lays them longitudinally in the hollow, and secures them in position by the secretion of mucus from his skin. Next he begins to build walls of similar materials, leaving an open space as a front door, and finally adds a roof. The whole structure is described as about one inch in diameter.

By this time the stickleback has attained his utmost degree of brilliancy, and swims abroad to seek a bride. There are plenty of more or less eligible and attractive maidens in the neighbourhood, for these little fish, notwithstanding the inveterate pugnacity

of the males, are intensely social in their habits ; but we are assured that the chevalier is by no means ready to pay court to the first comer. He may inspect and address many females before he finds one to his taste. Probably, if we could read his motives, we should find that they were profoundly utilitarian, and that he is looking for a mate in whom, as his senses or instinct inform him, the ova are ripe for spawning. Having made his choice, the bridegroom conducts the nymph toward the nest, with elaborate gestures of attention. Sometimes she is coy.

"Pooh !" says she, "you don't expect me to put my nose into a dark hole like that ? Let us stay out in the sunshine and do some flirting." "I assure you," we may imagine him replying, "it is not a bad place. It may be a bit rough outside, you know, but it is awfully snug within. Pray do me the great favour to enter and lay an egg or two." "Oh, don't bother !" says the maiden. "There is lots of time. It is much jollier out here ; besides, I like seeing what is going on in the world. It is so dull within doors."

After a little more discussion, the master of the house begins to exert his authority.

"Come, now," says he, "I have not much time to spare. The season is getting on, and I have been at a lot of trouble fitting up my little place for you. If you don't care to make use of it I must go and find somebody else."

An arrogant speech, no doubt, inspired as much by confidence in an exceedingly effective set of offensive weapons as by the knowledge that there are plenty of marriageable sticklebacks not far off. If the lady still hesitates, he sets up his spines and dashes about in an agitating way, trying to the steadiest nerves. Perhaps he gives her an admonitory nip or two with his powerful little jaws, and finally she whisks into the nest, lays

a few yellow eggs, and bores her way out through the wall at the opposite end, thus creating a back door to the premises. Then the husband enters and pays the necessary attention to what she has left behind, and the rest of the day is spent in the usual occupation of combat and quest of food.

Next morning the same process is repeated ; but, if we are to accept the evidence of close observers, not always with the same lady. The private morals of great soldiers and sailors (and the stickleback combines the attributes of both) are not always exemplary : provided the master of this queer little house can get the full complement of eggs stored therein—sixty to eighty, says Von Siebold—he is not very scrupulous about whom he can induce to lay them. Once the tale is complete, he dismisses his harem and builds up both doors, remarking, as he does so, “No admission except on business, and nobody *has* any business on my premises.” Then he takes up his station outside, truculently driving away all intruders, and especially careful not to allow the mothers of his family to interfere with his charge, knowing, probably, that they could not be trusted with each other’s eggs. Every now and then he pulls out a hole in the nest and enters himself, just to see that everything is correct. The length of his vigil is from ten to thirty days, according to the temperature of the water. When the swarm of tiny sticklebacks begin to escape from the eggs, the male parent assumes sole charge of them. The mother or mothers are goodness knows where—attending race-meetings, no doubt, playing bridge, or slumming in the East-end, whatever may be the subaqueous equivalents to such pursuits, according to their different temperaments. It is the father unaided who runs the nursery, catching food for the little ones, and masticating it himself before he puts it before them. For the first week or so after hatching he keeps his offspring closely confined in the nest ; then, when they are three or four millimetres in length, he

pulls the home to pieces, and the family assembles on the ruins. In the larval form the young fry are provided with natatory membranes extending the whole length of the body. At the age of twelve days or so these are absorbed as the fins and spines begin to appear, and shortly afterwards a colony of perfect little fishes swims forth to take the chances of this unequal world.

It is a strange history, which any one may verify for himself. So entirely are the cares of the family concentrated in the male that, should he be captured or otherwise come to grief during his period of guardianship, the nest is torn to pieces by other sticklebacks and the contents devoured. It is supposed that in the manner described the male stickleback usually constructs three nests, and rears as many broods of from sixty to one hundred and twenty fry in the course of a single season.

In spite of its diminutive form, and, proportionately, still more diminutive mouth, this stickleback destroys a prodigious number of the young of other fish. Günther records that a single stickleback confined in an aquarium devoured, in five hours' time, "seventy-four young dace, which were about a quarter of an inch long, and of the thickness of a horsehair. Two days after it swallowed sixty-two, and would probably have eaten as many every day could they have been procured. Nor have these restless little creatures any respect for larger fish. Mr. Houghton tells of a small pike which he kept in the same tank with some sticklebacks. The little wretches were perpetually nibbling at the pike's tail fin, which is as though a pack of school-children should amuse themselves by twisting the tail of a tiger. Often the larger fish would dash among his tormentors, and, seizing one of them, try to swallow it. He never succeeded; the spines were too much even for jaws so well armed, and the malefactor was speedily ejected. Day by day the luckless pike's tail fin diminished in size, till Mr. Houghton, commiserating

his sufferings, took him out of the tank and placed him elsewhere.

It is a remarkable thing that, whereas the size of most predaceous fish seems to have no defined maximum limit, but depends directly upon the amount of food secured, that of the stickleback remains fixed. Thus, while the pike attains the weight of 25 lb., 30 lb., 40 lb., and even more in well-authenticated instances, there are numerous lakes, where the food supply is limited, where it rarely reaches 10 lb. But in the case of the stickleback, feed it never so generously, it will not much exceed the length of three inches. Mr. Keene mentions that he has seen sticklebacks fall victims to their own voracity, the spines having become entangled in the glutinous substance surrounding frog spawn on which the fish had attempted to make a hearty meal.

The three-spined stickleback, in its various varieties of form, is very widely spread over the waters of Temperate and Arctic Europe; and closely allied forms, *Distribution.* distinguished dubiously as species, inhabit the waters of Greenland and North America. But none of the genus have been identified in the tropics, nor in the Southern Hemisphere. I do not know that this fish is turned to any economic use at the present time in Britain, but Pennant mentions the extraordinary numbers which used to appear in certain years in the river Welland at Spalding, where the peasantry used to scoop them out in millions, and apply them as manure to the land. They used also to boil them for the oil they contained, as is done in Sweden and France at this day. Some idea of their abundance may be had from an instance cited by the aforesaid writer, namely, of a man employed by a farmer to collect sticklebacks for manure, who was paid at the rate of one halfpenny per bushel, and earned in the season at the rate of four shillings a day. It has been observed that the stickleback is very scarce in the Thames. It is quite at home in brackish, and even in salt, water.

The Ten-spined Stickleback (*Gasterosteus pungitius*)

FIN FORMULA.

First Dorsal: no membrane, 10 spines.*Second Dorsal*: 9 rays.*Pectoral*: 11 rays.*Anal*: 1 spine, 9 or 10 rays.*Ventral*: 1 spine, 1 ray.

TEETH.

Villi-form, in both jaws.

The ten-spined stickleback resembles the three-spined in habits and disposition, being strongly gregarious, and, at the same time, intensely pugnacious, but it is not nearly so numerous as the other, at least in Britain. The colour of the males, however, is not nearly so brilliant as in the other species, the breeding dress in England being plain black. It has from nine to eleven dorsal spines, which can be erected at will. In other respects the general features are much the same in both fishes. The Scandinavian traveller and sportsman Lloyd has described the industry of fishing for sticklebacks in Sweden. It begins in November, and the method is for two men to go by night in a boat to some bay where ripples betray the presence of a shoal. One of the fishers holds aloft a torch, the other plies a small-meshed landing-net, and the boat is sometimes filled two or three times in a single night. The fish are boiled for oil to be used as an illuminant, the produce averaging about half a gallon of oil to the bushel.

CHAPTER VI

THE BURBOT AND THE FLOUNDER

The Burbot, or Eel-Pout—Appearance—Habits and Distribution—The Flounder—Appearance—Habits.

Third Order : Anacanthini, or Spineless-finned Fishes

LEAVING now the spiny-finned fishes we descend two steps in the Teleostean scale, and, leaving out the Second Order—the *Acanthopterygii Pharyngognathi*, which include the wrasses, coral-fishes, and some of the most brilliantly coloured creatures that exist — we arrive at the Third Order, the *Anacanthini*, or Spineless-finned Fishes. In these the dorsal, anal, and ventral fins are spineless ;* and the ventral fins, when present, are placed at the throat, instead of on the abdomen. An exceedingly important order is this to man, containing as it does the *Gadidæ*, or Cod Family, and the *Pleuronectidæ*, or Flat-fishes, which furnish so great a proportion of the food supply of the world. Yet out of the very large number of species making up these two families, two only can be reckoned as regular inhabitants of British fresh waters.

First Sub-Order : ANACANTHINI GADOIDEI : THE COD-LIKE SPINELESS FISHES

Fish in this sub-order are distinguished from those in the next by their heads and bodies being symmetrically formed.

* The only exception to this characteristic of the order occurs in an Australasian fresh-water genus, *Gadopsis*, which has spines in the dorsal and anal fins.

Second Family, GADIDÆ: THE COD FISHES

The Cod Family are known by their elongated form, and their small, smooth scales. They have one, two, or three dorsal fins; one or two anal fins; ventral fins placed on the throat, and generally containing several rays, but sometimes reduced to a mere filament, in which case the dorsal fin is divided into two. All the fins are spineless. The family consists almost entirely of marine fishes; indeed, in the whole known world only two or three species have been identified as fish of the fresh water.

The Burbot, or Eel-Pout (*Lota vulgaris*)

FIN FORMULA.

First Dorsal: 14 rays.

Second Dorsal: 68 rays.

Pectoral: 20 rays.

Ventral: 6 rays.

Anal: 67 rays.

TEETH.

Villiform; of equal size; small and pointed, in dense rows on the jaws, and stronger on the vomer; none on the palatal bones.

The singular creature called the burbot, or eel-pout, is the only representative of the great Cod Family in British inland waters. The first of these names is a modification of the French *barbote*, the bearded fellow, from the Latin *barba*, a beard; and arises from a long wattle, or barbule, which hangs from the middle of the chin, forming a conspicuous feature of this fish, although its object and functions are unknown. The second name, eel-pout, is as old as Saxon times—*ælelepútan*, eel-pouts, being mentioned in Ælfric's Anglo-Saxon Glossary of the tenth century, and has been explained to refer to an alleged power of the fish to puff out, or "pout," the membrane covering the fore-part of the head*; but in the absence of definite evidence as to this accomplishment, I would venture to suggest that the name simply means the fat eel, from the

* See Skeat's *Etymological Dictionary*.

root PUT, whence come the words "pod" and "pudding." Such an appellation would roughly denote the general appearance of this fish, for it has a greatly elongated body and a prominent stomach. The head is wide and rather flat; the eyes are placed laterally—that is, on the sides of the head. The body is covered with scales, which are described as embedded in the skin, so as to give the whole surface a pitted appearance. The general ground colour of back, sides, and fins is olive-green, with a marbling of dark brown or black. The under-parts are lighter, tending to white. Like all the Cod Family, the burbot is well furnished with fins, having two dorsal fins; the base of the second covers half the entire length of the animal, and is well balanced by the anal fin, which, however, has a slightly shorter base. The caudal fin is peculiar, shaped like a leaf or broad spear-head, resembling that of its near relative the ling. The pectoral fins are broad and rounded, and the ventral fins are immediately under the throat. Although living on the bottom, like the ling, the burbot is furnished with a long air-bladder. In England its length is often from one foot to two feet, and its weight from 2 lb. to 3 lb.; but it seems to be one of those plastic creatures which can adapt their stature to their means of sustenance, for it has been reported from the Rhine of the weight of 30 lb.

In habit the burbot is as retiring as the miller's thumb, living chiefly in holes and under stones during the day, whence country people sometimes call it the coney fish. In such places it lies in wait for its prey, which consists of other fish, or almost any living creature which it is strong enough to tackle. It is, however, chiefly a nocturnal feeder, which deprives it of all value in the angler's esteem; but its flesh is said to be excellent, and in places where it abounds it is diligently fished for with night-lines, nets, and eel-baskets. It is reputed to be in best condition for the table during the spawning season,

which varies according to locality from November till March. When engaged in reproduction, burbots assemble in numbers and lie closely intertwined with each other at the bottom of the water.

The burbot is very widely distributed over Central and Northern Europe and North America, extending from the north of Italy to Sweden, and, according to Yarrell, as far east as India. But in England it is so very local as to suggest some curious speculation. How comes it that a robust and prolific fish which is at home in the Trent is absent from the Thames, which geologists hold to be the older river, once a tributary of the Rhine, where burbots abound? Mr. Keene, indeed, states that he once took one (he does not say how) from the Wey, near Weybridge, weighing half a pound; but he adds that none of the people in that neighbourhood had ever seen a fish of the kind before. The occurrence of a single individual of a species could only be accounted for by supposing that it had made its way through canals into the Thames watershed; but there is evidence to prove that the burbot once was indigenous to the Thames and its tributaries. Mascall, already referred to as the author of the *Booke of Fishing with Hooke and Line* (1590), has the following interesting note about this fish:

“There is a kind of fish in Holand,* in the fennes beside Peterborrow, which they call a poult; they be like in making and greatness to the whiting,† but of the cullour of the loch [loach]; they come forth of the fennes brookes, into the rivers nigh there about, as in Wandsworth river‡ there are many of them. . . . They are taken at milles in welles [eel-baskets], and at waters [weirs] likewise. They are a pleasant meate, and

* Not the kingdom of Holland, but the south-eastern division of Lincolnshire which bears this name.

† A true analogy; the whiting, like the burbot, belonging to the Cod Family.

‡ The Wandle, which falls into the Thames at Wandsworth.

some do thinke they would be as well in other rivers and running waters, as Huntingdon, Ware, and such like, if those waters were replenished as they may be with small charge. They have such a plentie in the fenne brookes, they feed their hogges with them. If other rivers were stored with them, it would be good for the common wealth, as the Carpe which came of late yeares into England. Thus much for the fenne poult."

At the present day the burbot is not known to survive in the Thames system. It is a strange thing that it should have disappeared, and Mr. Keene's mention of the capture of one in the Wey suggests the possibility of the species still lingering in its ancient haunts, shielded from observation by its retiring and nocturnal habits. Plot, in his *Natural History of Staffordshire* (1686), mentions the burbot, but says that it is called, "from the oddness of the shape and rarity of meeting them, the *Non-such*; there having never been but four (that I could hear of) found within memory." Yet it is certain that there were plenty of burbot in Staffordshire waters in the seventeenth century, as there are in the Penk and other tributaries of the Trent at this day. At all events, this fish is strictly limited in range within Britain to certain eastward-flowing rivers, once connected with the great Rhine system.

Were we as a nation more careful than we are to develop the natural resources of our waters, the burbot would undoubtedly repay care in its propagation, for it would thrive at the expense of less valuable fish in many ponds and lakes now exclusively inhabited by inferior fish. It is equally at home in running and still waters, and would probably pick up a living wherever eels can do so.

A word of warning as to the use of fishes in general for food may be appropriately spoken before dismissing the burbot. To enter into the life-histories of the internal parasites of fish would extend this work far beyond the limits assigned to it;

but the burbot and the pike are the hosts of a peculiarly formidable parasitic worm, which causes great distress to human beings in those countries where it is the custom to eat these fish raw ; wherefore a brief notice of *Bothriocephalus* may not be deemed out of place.

Bothriocephalus latus is one of those so-called worms, of which the tape-worm (*Tænia*) is the type, which, at certain stages, inhabit the intestines of vertebrate animals, and at other stages establish themselves in the muscles and other organs of the body, setting up serious disturbance and in extreme cases causing death. The creature consists of what is called a head, but which is really nothing more than a mechanism of attachment, whence springs a rapidly-growing chain of joints. At first these joints are slender, but they gradually increase in size until, at a certain distance from the point of attachment, they develop sexual apparatus, and each joint becomes a complete individual, remaining, however, a link in the lengthening chain. The total length of the chain, or colony, may be as much as twenty to thirty feet. This unlovely community lies at ease, absorbing nutriment from the food swallowed by its host, each joint or individual in the chain forming within itself a number of eggs, which, when ripe, are expelled, and, in order to fulfil their destiny, must pass, it is believed, into the water. There a free-swimming organism escapes from the egg, finds its way into a burbot or a pike, and lodges itself as a sexless bladder-worm in the muscles of the fish. There it awaits passively further development, which comes when the uncooked flesh of the fish is eaten by man, dog, or other animal, and each bladder-worm becomes the "head," or anchor, of a new colony of the so-called worm. Luckily there exists some prejudice in this country against eating raw fish ; in certain parts of Scandinavia, Russia, and Central Europe, where the peasantry dispense with that precaution and eat pike and burbot uncooked, they suffer very considerably from this filthy parasite.

*Second Sub-Order: ANACANTHINI PLEURONECTOIDEI: THE SPINELESS
SIDE-SWIMMERS*

The second sub-order or division of the Spineless Fishes contains those fish which are distinguished by the asymmetrical form of the head and part of the body. It consists of a single Family.

PLEURONECTIDÆ: THE FLAT-FISH FAMILY

Precise expression is not only indispensable to exact science, but inseparable from exact thinking, and the judgment of a loose or obscure talker may safely be set down as not worth having. It is generally right, therefore, to demur to the epithet "extraordinary" being applied to any genus or species. What is usually meant when that word is so applied, is that the creature referred to is of remarkable appearance or behaves in a remarkable way; but it cannot be correct to speak of an animal as "extraordinary"—out of the common—which conforms in appearance to the normal character of its genus, and complies with the uniform habits of its kind. Yet when we come to consider the great family of *Pleuronectidæ*, or flat-fishes, it is almost justifiable to describe them as extraordinary, for they form a group of animals, unique in one respect among all known living creatures, in that they carry both eyes on one side of the head. This is the more remarkable, inasmuch as these fish when hatched from the egg are perfectly symmetrical, swimming in a vertical position like other fishes, and carrying an eye on each side of the head. This much is certain, in regard to all the flat-fishes; the subsequent changes in position and structure are still far from being clearly understood. The larval forms of the different genera and species so closely resemble each other as to make it difficult to pronounce upon their respective parentage. All of them lose the power of retaining a vertical position, partly owing to want of an air-bladder, and partly from defective balancing power in the

pectoral and ventral fins ; they then turn over on one side (in most flat-fishes it is the right), and for the rest of their lives continue to rest and move upon that side only. The exposed side takes on characteristic colouring, usually in close assimilation to the surrounding ground ; while the side next the ground becomes white, like the bellies of other fish, and is called the "blind" side.

Of course this change in position causes one eye to rest upon the ground, to the manifest detriment of its functions ; but this is rectified by its withdrawal from the blind side, and its rearrangement on the coloured side. Naturalists are not of one opinion how this is effected. Some consider that the eye, yielding to its natural tendency to turn towards the light, turns round upon its axis, and, forcing its way through the cartilages and bones of the head, assumes a position beside and in front of the other eye upon the upper side. Others hold that it moves round from below, carrying with it the whole fore-part of the head. Whatever be the exact process, it is a very singular one, and highly suggestive in regard to the forces at work in the modification of form in living organisms.

Flat-fishes seem to be a very modern type, for the only example found in a fossil state is a species of turbot from the tertiary beds of Mount Bolca.

The Flounder (*Pleuronectes flesus*)

FIN FORMULA.

Dorsal : about 60 rays.

Pectoral : 10 rays.

Ventral : 6 rays.

Anal : 39 to 45 rays.

Caudal : 14 rays.

TEETH.

Teeth on the jaws, of moderate size, more developed on the blind side than on the coloured one. No teeth on palate or vomer.

In Britain the fresh-water representatives of the flat-fishes are of modest proportion, never approaching in size to the lordly halibut, whereof the weight is sometimes reckoned,

not in pounds, but in hundredweights. Even the flounder, which has the best claim in this family to be reckoned as a river-fish, is better known as a sea-fish; but it often ascends rivers considerably beyond the influence of the tide. Before pollution closed the estuary of the Thames to the ascent of sea-fish, flounders were taken in large numbers as high as the navigation weirs would allow them to go—namely, at Teddington and Sunbury. It is a tradition that under Westminster Bridge was once a favourite pitch for them. The rivers of Holland and Belgium abound in flounders, which wander so far up the Scheldt and its tributaries as to appear in the neighbourhood of a place with few maritime associations—namely, Waterloo. The migration of the flounder, unlike that of salmon and eels, does not appear to be connected with reproductive purposes, nor is it regularly seasonal. Probably food and refuge are the determining motives, and the ascent of young eels in myriads from the sea no doubt induce flounders to follow them.

In regard to the common name for this fish, there is no reason to search for an origin more remote than the obvious one of a creature that flounders and flaps about when caught; and perhaps the same idea is conveyed in the synonym “fluke,” which is the older name for the fish in this country, being from the Anglo-Saxon *flȝc* (*Ælfric*, 10th century). It is to be noted that in the Solway district the name of flounder is applied popularly to the more excellent plaice.

In aspect this fish is the reverse of imposing. Most countenances would suffer in expression by the transplantation of the left eye to the right part of the forehead, and **Appearance.** to this the flounder offers no exception. Moreover, the severe lateral compression which the figure of the animal has undergone has increased its breadth to the proportion of two-thirds of the entire length, which must be pronounced detrimental to elegance. The expanse of flat side thus created affords a fine field for the display of startling colours in which

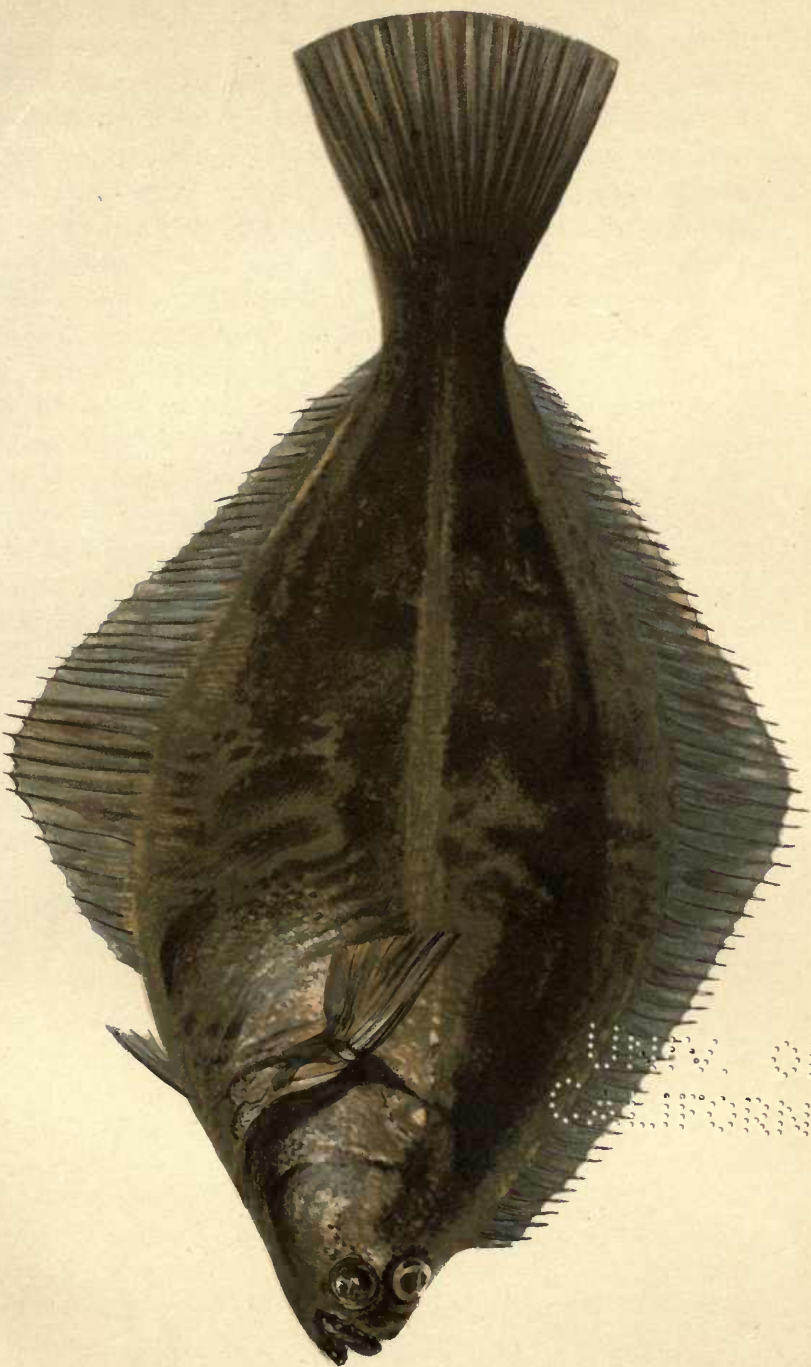


Photo by P.D. Malloch

THE FLOUNDER (*Pleuronectes flesus*)

$\frac{2}{3}$ Natural Size

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Nature sometimes indulges ; but here utilitarian consideration for the need of concealment has prevailed, and the flounder becomes closely assimilated to his environment. Mud gives the easiest lying, therefore muddy flats are his favourite haunt, and muddy tints darken his skin, sometimes faintly enlivened by yellowish spots ; but on a clean sand bottom the fish assumes a corresponding livelier tint, and white or albino individuals are occasionally taken. As mentioned above, most flat-fish lie on their right side, but flounders and soles generally do so on the left, and conform to the command "Eyes right !" but there are individual exceptions.

The apparent breadth of the flounder is greatly increased by the peculiar arrangement of the dorsal and ventral fins, which form a broad fringe round the greater part of its circumference. The dorsal fin, containing about sixty rays, starts above the eyes and extends to the thin part of the tail, the rays being longest at a point more than halfway towards the tail. Exactly opposite are the longest rays in the anal fin, which, however, contains only from thirty-nine to forty-five rays, commencing behind the pectoral fins. The pectoral fins, with ten rays, are alike on each side of the body, which is singular, seeing that the action and function of that on the upper side must be permanently different from that on the "blind" side. The caudal fin, with fourteen rays, is long, square-cut, and effective. The ventral fins are short, with six rays each, and are placed rather further forward than the pectoral, in keeping with the general anomalous structure of the family. In the case of a gentleman who carried both eyes on the same side of his nose, it would add but mildly to our surprise to find that he wore his waist-belt round his neck.

The flounder spawns in spring, the date varying, according to climate, from February to May. The ova are provided on a prodigal scale, upwards of one million and a quarter having been reckoned in a single fish weighing $1\frac{1}{2}$ lb., and are scattered on the pelagic system—

Habits.

that is, they float loose in the ocean, at the mercy of winds and currents, until the free-swimming larval form is hatched. The food of the flounder consists of small creatures, such as worms, crustaceans, etc. It is a favourite with estuarine anglers, biting freely at a bait of worm or soft crab. Its flesh is palatable and nutritious, but of rather watery flavour. It is of the kind which profits greatly from the offices of a good cook. Living as I do on the shores of the Bay of Luce, I used to cherish the belief that the flounders of that fair gulf were superior to any others. It is true that the flounders served to me were larger, sweeter, and firmer than any I encountered in other districts; but the illusion was dispelled when I found that the Luce Bay flounders were really plaice, locally known as flounders, while the term "fluke" is reserved in that district for the flounder itself.

In size the flounder rarely exceeds nine inches.

The sole (*Solea vulgaris*) and the plaice (*Platessa vulgaris*) both frequent estuaries at times, and it is said that they sometimes ascend rivers to the extreme limit of the tide; but it appears to me that to include such essentially marine species among our fresh-water fishes is to strain the definition beyond what it will justly bear.

CHAPTER VII

THE CARPS

The Carp—Appearance—Distribution—Habits—Angling for Carp—The Crucian Carp—Distribution—The Golden Carp, or Gold-Fish.

Fourth Order: Physostomi: Bladder-duct Fishes

IN leaving the *Anacanthini*, or Spineless Fishes, and taking up the fourth order of Teleosteans, namely, the *Physostomi*, or Bladder-duct Fishes, we get into contact with an older type of animal, the remains of which are abundant in certain geological deposits of the Tertiary era. The distinctive marks of this order are the connection of the air-bladder, where present, with the mouth by a pneumatic duct (except in the *Scombresocidæ*), and the articulation of all the fin rays, save where in certain species the first ray in the dorsal and the first in the pectoral are ossified. The ventral fins are spineless, placed on the abdomen.

Passing over the great family of *Siluridæ*, or Cat Fishes, and the smaller and exclusively marine one of *Scopelidæ*, we come to the third family in this order, an exceedingly important one in British ichthyology.

Third Family, CYPRINIDÆ: THE CARPS

The carps comprise most of the fresh-water fish of the northern hemisphere in both the Old and the New World. They are also well represented in the tertiary deposits of

Europe, Asia, and North America, most of the fossil species being referable to existing genera. The body is usually clad with scales, the fin rays are articulated, the jaws toothless, but the pharyngeal bones are furnished with teeth in one, two, or three rows. The air-bladder is large, divided by constriction into two portions, enclosed in a bony capsule. Dr. Günther has subdivided this family into fourteen groups, whereof the second, *Cyprinina*, includes the true carps.

The Carp (*Cyprinus carpio*)

FIN FORMULA.

Dorsal: 21 rays, of which the first is bony and serrated.
Pectoral: 16 or 17 rays, of which the first is bony.
Ventral: 10 rays, of which the first is bony.
Anal: 8 rays, of which the first is bony.
Caudal: 17 to 19 rays.

TEETH.

Jaws toothless;
 pharyngeal teeth
 in three series,
 molar-like.

The carp is not indigenous to Britain, being a native of Chinese waters, but it has become thoroughly naturalised over the greater part of Europe. The name is of unknown origin, having found its way into every European language, and thence meandered back into late Latin, being mentioned by Cassiodorus (XII. 4) in the fifth century. Probably the Eastern name travelled westward with the fish, for Aristotle speaks of a fish with a soft, fleshy mouth, which he calls *κυπρίνος*—*cyprinus*—apparently the same word as “carp” by transposition of the second and third consonants.

There be writers who confidently fix the exact date of the introduction of the carp into England, and others there be who, with equal confidence, give different dates. Dame Juliana Berners, writing in 1486, mentions it as “a daynteous fysshe, but there ben but few in Englonde, and thereforre I wryte the lesse of hym.” It is a pity that, while they were about it, its importers had not chosen a better fish. Fish

life, water area, and food supply bear immutable proportion to each other; in a country like ours, where the rivers are not of great volume, and many have been polluted beyond redemption, where also the total area of lake and pond is but a moderate one, it behoves us to exercise extreme caution in the introduction of exotic species. The carp, it is true, is not destructively predaceous, but as a food fish it takes a low rank, and its excretal discharges sully the purity of many ponds, otherwise well suited for a stock of valuable *Salmonidæ*. It is a fact seldom realised by owners of land that the presence of carp in their waters often exercises an important and deleterious effect upon the landscape. There is no more charming feature in park scenery than limpid pools; yet I know of many instances where the water in ornamental ponds is rendered permanently turbid in the summer months, solely by the unlovely habits of the carp which inhabit them. It does not diminish one's dissatisfaction to remember that the carp is peculiarly subject to the presence of large internal parasites; wherefore the water thus polluted is not only unpleasant to the eye, but charged in an indefinite degree with organisms hurtful to other forms of life. From the windows of the romantic château of Azay-le-Rideau, in Touraine, I have watched enormous carp rolling lazily in the sunshine in the moat surrounding that enchanted palace. From time to time one of these great creatures would discharge a volume of impurity, sullyng still more the already turbid water, so that the lazy form of the fish became obscured in a veil of its own filth. How much better, methought, it had been if, instead of these great Asiatic fish, the unpolluted waters of the moat had been made the home of companies of gaily-striped perch or lusty trout.

Howbeit, in personal appearance the carp is far from unattractive, and has an aristocratic air, partly native, partly from association with dignified, affluent pleasure-grounds. It is a fish subject to considerable variation in different waters,

but in well-nourished individuals the greatest depth is most often equal to about one-third of the length. The lips are yellow, thick, and fleshy, usually, but not invariably, carrying four barbels, two of an olive colour hanging from the upper jaw, and two longer ones, coloured red or yellow, at the corners of the mouth. The eyes are large and well-set, with golden irides. The body is clothed with thick scales, so large as to number only thirty-five to thirty-nine along the lateral line, the diameter of each scale being greater by one-half than that of the eye. The prevailing body tint is bronze, brownish, or bluish on the back, blending into brassy and golden tints on the sides, and fading to something approaching white on the under parts.

The single dorsal fin, of a grey colour, contains seventeen to twenty-two rays, whereof the first is bony and serrated. The base of this fin extends over about one-third of the length of the body. The caudal fin is purplish in hue, and is divided into two equal rounded lobes containing seventeen to nineteen rays. The pectoral and ventral fins match the caudal fin in colour ; the anal fin is reddish-brown with orange rays.

Dr. Günther says that the growth of the carp is perhaps more rapid than that of any other fresh-water fish. This would be a difficult thing to prove, seeing how much the growth of most fish, and the size they may attain, depends upon the abundance of food. The carp has this advantage over most of his rivals, that his diet is to a large extent vegetarian. He is able to make many a hearty meal where carnivorous fish must go fasting. But it would be an interesting experiment to match against each other different fish of those kinds which have no definite limit of size by putting them in stews, supplying them regularly with as much provender as they could consume, and weighing them against each other at the end of a year. There might be found somebody bold enough to enter a pike, or even a rainbow trout, at scratch against Dr. Günther's carp.

The carp is one of those fish which own to no normal stature or weight ; but, just as no precise limit can be assigned to its proportions, so none can be set to the wild stories long current about the size of individuals. There can be little doubt, however, that in Germany these fish are sometimes taken of the weight of from 30 lb. to 40 lb. The records of heavy carp in England are open to cavil, owing partly to the neglect of precision in making them, and partly to the well-known characteristic of all sporting fish to increase in weight year by year after death ; but there is nothing unusual in the occurrence of carp from 10 lb. to 15 lb. in weight in British waters.

The late Frank Buckland received one of $21\frac{1}{2}$ lb. from Mr. Charles, the fishmonger of Lower Grosvenor Place, of which he took a cast, and another of $16\frac{1}{2}$ lb. ; but he has omitted to record where these fish were caught—whether in England or on the Continent. There is also a well-authenticated instance of a carp weighing $24\frac{1}{2}$ lb., netted from Harting Great Pond, near Petersfield, in 1858. If the size of carp be a matter of uncertainty, still greater is the difficulty in ascertaining their normal duration of life. Marvellous stories have been supplied for those curious in such matters—and by what easy transition do the curious become the credulous !—but of trustworthy evidence the absence is almost complete. There is good reason to suppose that the carp exceeds most fish in longevity ; it leads a leisurely life in tranquil waters, exposed, indeed, to the attacks of a variety of parasites, but protected, as a rule, from violent catastrophe, and singularly discreet in accepting the lures of any but the most crafty anglers. Still, the even tenor of the carp's life is not altogether exempt from the vicissitudes of human politics, and the great carp in the ponds at Versailles, reputed to be the original fish placed there in the reign of the Grand Monarque (1643-1715), are believed to have shared the fate of other privileged classes at the hands of the revolutionaries

in 1790. Be the natural term of its years what it may, the carp is tenacious of life in a degree far beyond most other fishes, and will live for an indefinite time simply wrapped in wet moss.

As already mentioned, the carp is an Asiatic fish, but the ease with which it can be transported alive for great distances, wrapped in damp cloths or herbage, has been the *Distribution.* reason of its establishment in probably every European country. In Britain its distribution is very arbitrary ; wherever religious communities formerly existed, the carp is pretty sure to survive in the neighbouring waters, except in the north, where the streams are generally too rapid and the winters perhaps too cold. Yet one sometimes comes upon carp in the mild west of Scotland in places where one would least expect them. On my own property in Galloway there is a lonely little tarn situated close to the seashore, but on the top of a cliff about one hundred feet above sea-level. There is no stream flowing into it, neither is there any visible outlet except in time of flood ; it is but a basin in the boulder clay, and the whole surface does not extend to a couple of acres. Behind it rises a steep, wild fell ; before it stretches the expanse of St. George's Channel. There is not a human habitation in sight ; a more lonely spot could scarcely be imagined. It is a favourite haunt of wildfowl, and in old times I used to make my way to it occasionally to secure a brace of ducks. Not suspecting that it contained any fish, it occurred to me long ago to turn in some trout, which was done, and the incident was forgotten. Years afterwards I happened to stand on the shore of this little loch on a summer day, when suddenly a resounding splash echoed among the rocks. A great fish had leaped itself from the dark waters, and a few minutes later another rolled up in a sidelong way. I never doubted that these were the long-forgotten trout which appeared to have grown to amazing proportions ; and next day I returned with a fly rod, prepared for spirited action.

But further exhibition on the part of the inhabitants of the tarn convinced me of their real character. A few trout there were, and of goodly proportions ; but the salmon-like plunges which had strung my nerves so sharply were those of great carp. How came they there, so far from the haunts of men ? It was a puzzle, till, in the course of enquiry, I encountered a tradition that they had been introduced by a certain Admiral long since dead, to serve his table withal. There they had lived and moved and had their being, within sound of the sea, no man troubling them, and there they may remain for aught I shall ever do to disturb them.

Similarly, in Ireland, carp are found in various scattered localities. Gossip Buckland tells of a nameless lake in that country whereon the peasants informed him that fairies might be seen dancing by the light of the moon. He had the curiosity to visit it under the prescribed conditions ; he saw no fairies, but beheld the calm water ringed and dimpled by the antics of great carp "smacking their lips as they took in gulps of air." *

Carp dislike strong water, and although they thrive in the Thames and many other rivers, it is only the sluggish parts of them that they frequent, and they may be considered
Habits. as sharing with the tench the attribute of being a distinctively pond fish. In their diet they may be termed omnivorous, browsing freely upon grass and water weeds, but far from disdaining worms, larvæ, and small fish of other species. To say that the Germans excel the English in the skilful culture of fish is to pay them a very poor compliment, for it is only within recent years that pisciculture has taken rank among the industries of Great Britain. Even so, it is confined almost exclusively to the *Salmonidæ* ; but in Germany the carp is carefully reared and fed as an article of food. Of the herbivorous character of this fish full advantage is taken ; the system being to run the carp ponds dry once every seven

* *Natural History of British Fishes.* London, 1880, p. 41.

years. The bottom is sown with rye grass, of which a heavy crop is cut and the consolidated mud is then dug away. Next, the ground is sown with mixed grasses, and as soon as these have formed a continuous turf, the pond is refilled and stocked with young carp, which feed upon the new pasture like a drove of cattle. When the grass is done, hand-feeding is resorted to. Even the art of castration, used from immemorial times to hasten the fattening of domestic animals, is applied to carp, and it is said that those fish in which the ovaries have been destroyed are far better on the table than others. But when I read in a recent work of considerable merit * that Sir Hans Sloane demonstrated the process of castrating carp before George IV., I am reminded with what reserve all fishermen's tales should be received. Sir Hans Sloane died in 1753, at the age of ninety-two ; George IV. was born in 1762 ! I will fall back, therefore, and quote Dame Berners once more, who says most discreetly of this very fish : " I haue but lytyll knowlege of it, and me were loth to wryte more than I knowe and haue prouyd."

Carp usually spawn in May or June, the males becoming very demonstrative at that season. The female esconces herself in a convenient weed-bed, and quietly deposits her spawn, which is greenish in colour. Usually two or more males remain in waiting upon her, giving expression to their impatience by leaping from the water after the manner of a salmon. Von Siebold describes the process of impregnation. When the female has deposited her quota of eggs for the day, and swims away to sun herself or to search for food, one of the attendant males dashes on to the vacant bed and distributes his milt around the ova. The eggs are very small and numerous, being reckoned as amounting to three-quarters of a million in a female weighing 10 lb. But this proportion is far from fixed. Thus, whereas Frank Buckland found the roe of a carp weighing 16½ lb. to weigh 5½ lb. (nearly one-third

* *The Practical Fisherman*, by J. H. Keene. London, 1881.

of the total weight of the fish), and to contain 2,059,750 eggs, in a larger fish, weighing $21\frac{1}{2}$ lb., he found only 1,310,750 eggs.

It has been observed that the spawning season is sometimes very much prolonged, ova being deposited at irregular intervals during several months. Further, for some reason unknown, the spawn of successive seasons may be retained undischarged within the ovary, a result attributed by some writers to the action of large internal parasites, to the attacks of which the carp is peculiarly liable.

The carp is credited with sagacity far beyond the average of fishes, and it is certainly shy and capricious in taking a bait; but this may be owing chiefly to its staple ^{Angling for} ^{Carp.} diet being vegetarian, and the difficulty of hitting upon anything of superior attraction to the abundant summer pasture afforded by the waters. Being wholly without experience in angling for carp, I can only repeat some of the instructions given by those who have achieved success in that branch of field sports. Frank Buckland gives the following French receipt for ground-baiting: "Take a tuft of turf the size of a dinner-plate, the grass of which is green and short; then with a needle and green thread, sew on red worms so as almost to cover the turf; fasten the turf to a board and sink it to the bottom." But when the carp are collected round this ground-bait, the angler is by no means at the end of his difficulties, for the carp is very wary, and easily to be scared by any incautious movement. The tackle must be very fine, but faultless, for, as Dame Juliana Berners observed of the carp, "he is an evyll fysshe to take, for he is so strong enarmyed in the mouthe, that there maye noo weke harnys hold hym." If a worm be used for a bait, it is indispensable that it should have been well scoured from all earthy particles, within and without. Having placed it on the hook, it must by no means be flung under the nose of the fish in the rude manner which might serve one's turn with a perch. The delicacy of manœuvring required has been well described by Mr. Keene. That

gentleman, coveting greatly the conquest of certain great carp in Virginia Water, Windsor, used to watch them lying log-like at the surface basking in the summer sun. He had fine tackle, suitable rods, and other gear, but the difficulty was to get a bait out to them; for they mostly lay a couple of hundred yards from the nearest shore. Approach by punt proved not feasible: the fish invariably sank out of sight long before the angler came within range.

At last, under the stimulating influence of a pipe, Mr. Keene struck out a plan of campaign. Choosing a morning when there was a gentle breeze, he went afloat in the punt, which he allowed to float within fifty yards of where the fish lay, and then stealthily cast anchor. A fresh green pea was put upon a small hook attached to very light tackle, and a large chestnut leaf affixed to the gut. Line was paid off the delicate reel as the wind carried the leaf and bait through the air in the direction of the fish. After the leaf dropped on the water, the breeze continued to waft it in the desired direction, until the angler, trembling with excitement, had the satisfaction of seeing it pass right among the fish.

"All on a sudden, down went the leaf; the line tightened, and a terrific rush told that *Cyprinus carpio* had found his match. Now came the Greek-to-Greek combat. Right and left in turn, now down to the bottom, anon quite at the surface, was the fight prolonged; but, so far as Master Carp was concerned, it was in vain. After an hour's good sport—such sport as I never but once before experienced—he was landed, scaling $9\frac{1}{4}$ lbs."*

Mr. Keene confirms Izaak Walton's opinion that early morning in hot weather is the time when your carp is most ready to do business.

As a table fish, the carp never gets a fair chance in England nowadays. Taken in a pond, generally of small extent and polluted by the fish's own excretions, it is often

* *The Practical Fisherman*, by J. H. Keene, p. 73.

but indifferently nourished. Brought straight into the kitchen, where too often the culinary art runs on a very low and unimaginative level, it is submitted to the treatment suitable only for the finest of salt-water fish, and the result is deplorable. It was otherwise in old times in this country, when carp were very highly prized and carefully treated. The monks of old knew far better how to treat the Creator's gifts than to drag carp out of a miry pond and deliver them straightway upon the table, with all their impurities upon them, imparting a disgusting flavour of mud to the flesh. Having caught their fish, and knowing by the calendar exactly when they would be required for fast-days, they bestowed them in stews constantly replenished with pure water, and fed them up on boiled grain or other fattening material, calculated to sweeten and enrich the flesh. Treated in this way, it is easy to suppose that there was good foundation for the high esteem in which people of old used to hold this fish, and that the elaborate recipe given by Izaak Walton for the cooking thereof was not thrown away.

"I will tell you," says he, "how to make this carp, that is so curious to be caught, so curious a dish of meat as shall make him worth all your labour and patience. And though it is not without some trouble and charges, yet it will recompense both. Take a carp, alive if possible ; scour him and rub him clean with salt and water ; then open him ; and put him, with his blood and liver, which you must save when you open him, into a small pot or kettle. Then take sweet marjoram, thyme, and parsley—of each half a handful, a sprig of rosemary and another of savoury ; bind them into two or three small bundles and put them into your carp, with four or five whole onions, twenty pickled oysters, and three anchovies. Then pour upon your carp as much claret wine as will only cover him, and season your claret well with salt, cloves, and mace, and the rinds of oranges and lemons. That done, cover your pot and set it on a quick fire till it

be sufficiently boiled. Then take out the carp, and lay it, with the broth, into the dish, and pour upon it a quarter of a pound of the best fresh butter, melted, and beaten with half a dozen spoonfuls of the broth, the yolks of two or three eggs, and some of the herbs shred. Garnish your dish with lemons, and so serve it up. And much good do you ! ”

One can almost see the old gentleman's eyes twinkling and his lower lip trembling as he dictated these sumptuous directions ; but, after all, 'tis but a poor fish that cannot be relished with a simpler sauce.

The Crucian Carp (*Carassius vulgaris*)

FIN FORMULA.

Dorsal : 18 to 20 rays, of which the first three are bony.

Pectoral : 13 to 14 rays.

Ventral : 9 rays, of which the first two are bony.

Anal : 8 rays, of which the first three are bony.

Caudal : 17 rays.

TEETH.

Pharyngeal, in a single series of four on each side.

The Crucian Carp (*Carassius vulgaris*) has been placed by naturalists in a different family to that of *Cyprinus* on account of a different arrangement of teeth and the absence of barbels from the lips. Otherwise it bears a close resemblance in many respects to its greater relative, notably in colour of the skin and in the form and arrangement of the fins. It is, however, like the common carp, an exceedingly variable creature. In the type the body is very high and laterally compressed, the depth being about equal to one-half the length. In some waters it assumes a more elongated form, but even then it can be distinguished at a glance from small individuals of the true carp by the absence of barbels. The irides, also, which in the carp are golden, are generally of a silvery tone in the crucian carp, although some naturalists report them as golden with a tinge of red. It may be remarked in passing

that the irides of fish change colour very rapidly after death, and become suffused with congested blood, disguising the original tint. This is very well known to the purveyors in Italian towns. If, in Naples, you have the enterprise to resist the attractions of the French restaurants in the modern quarter, and repair instead to a native establishment of repute in the Toledo (now named Via di Roma), the waiter will bring you a tray of various fish, uncooked, so that you may choose the one you fancy. Now it is a trick of those who wish to palm off stale fish upon their customers to pull out the eye and insert one from a fresh fish. Hence the knowing guest indicates the fish of his choice by touching it on the eye, and ascertaining that it is fixed in the socket.

The crucian carp is no rival to the common carp in size, rarely exceeding six or seven inches in length; but, owing to its sturdy build, it sometimes weighs as much as $1\frac{1}{2}$ lb. or nearly 2 lb. In habits and food it resembles the larger species, except that it is more fond of the bottom of the water than the top, and is never seen on the surface except about midsummer, when it spawns. At that season these fish leave the deep water and crowd into the weedy shallows, laying their abundant spawn on the leaves and stems of water plants.

In Great Britain the crucian carp is said to occur only in the Thames and in ponds in the valley of that river—a restriction of range which suggests that it is an
Distribution. imported species. On the continent of Europe it covers a very wide region, extending from Sicily to Norway, and eastward to the Danube and Siberia. In most countries it is used chiefly for fattening other fishes, but in certain parts of the north of Europe it is said to be accounted, if not a delicacy, at least not despicable as food. Frank Buckland, who sampled the edible qualities of most creatures that move in the waters, says that the flesh of Prussian carp, which Dr. Günther accounts for as but an elongated variety of the

crucian carp, has not the muddy taint which naturally pertains to the common carp, and there must be few Englishmen who can check his experience by their own. For my own part, my acquaintance with this fish is limited to its behaviour in an aquarium, whereof I have found them docile denizens and easily managed. They accept gratefully consignments of breadcrumbs, varied with small earthworms; if you want to provide your captives with a special delicacy, turn in a cupful of those bloodworms which in summer stain the shallow parts of dirty ditches. They are the larvæ of different species of *Chironomus*, a gnat-like insect which abounds wherever there is stagnant water.

The term "crucian" has been a puzzle to some etymologists, and one does not arrive far on the road to its solution by explaining it as a corruption of the German name for this fish—*Karausche*—which has received a Latin form in the specific name for the genus—*Carassius*. Some confusion also has ensued from the name of Prussian carp given to the variety above referred to, and its distinction under the scientific title of *Carassius gibelio*. This, as well as the *C. moles* of Agassiz and *C. oblongus* of the Austrian naturalists, Dr. Günther regards as mere varieties of the crucian carp.

The Golden Carp, or Gold-Fish (*Carassius auratus*)

FIN FORMULA.		TEETH.
<i>Dorsal</i> : 16 to 19 rays, of which the first is curved, bony and serrated.		Pharyngeal.
<i>Anal</i> : 8 rays, of which the first three are bony.		
<i>Pectoral</i> }	Variable.	
<i>Ventral</i> }		
<i>Caudal</i> }		

The well-known Gold-fish (*Carassius auratus*) must be recognised as having acquired a permanent place among the fresh-water fishes of Britain, seeing that, although usually

seen in a domesticated condition, they have become perfectly naturalised in certain places. In others, it is true, where they have made themselves perfectly at home, their inheritance is a precarious one, depending on the high temperature imparted to mill-ponds by the waste steam from the engines of manufactories.

The wild type, which inhabits the rivers of China and the warmer parts of Japan, very closely resembles the crucian carp, both in colour and form ; so much so, that some naturalists refuse to recognise any specific distinction between the two races, and consider the remarkable metamorphosis of colour manifested in gold-fish merely as the result of domestication acting on the characteristic variability of the family. At all events, the change from dark colouring to gold may be regarded as an incipient stage of albinism, which in certain individuals proceeds so far as to reach white, when they are familiarly known as "silver-fish," although not really half so silvery as a fresh-run salmon or a bleak.

Not only is the gold-fish prone to change its colour, but it is liable to strange variation in form, leading to the production of monstrosities with contorted bodies, goggle-eyes, or exaggerated fins, known as Japanese fan-tails, telescope fish, etc.

In size the gold-fish averages the same as the crucian carp, and its natural habits are identical with those of that fish ; but its behaviour under abnormal conditions calls for some attention.

First, as to the endurance by the gold-fish of a temperature so high as to be destructive of most forms of aqueous life. Dr. John Davy, brother of Sir Humphry, left on record a series of observations which should establish once and for all the truth in this matter, and leave no excuse for further cruel experiments :

"A gold-fish of average size, taken from an aquarium and put into water at 96° Fahrenheit, immediately became restless, swimming about hurriedly and making violent leaps, as if attempting to escape. Gradually it became languid, swimming on its side, the caudal fin seldom acting. After a few minutes,

when the water had fallen to 90° , it appeared to be motionless ; the pectoral fins and opercula (gill-covers) were the last that ceased to act. Now transferred to water of 70° , it rapidly revived, the gills first acting. After an interval of about an hour it was put into water at 93° . This temperature it bore pretty well at first ; gradually it became languid, swimming on its side. As the water cooled, its languor abated, and when the temperature had fallen to 88° it had resumed its natural position."

Next, as to the change of colour under domestication, it is believed to be the result of a high water temperature—high, that is, in comparison with the mean temperature of water under the open sky. Mr. Houghton says that "in ordinary ponds of this country the usual and prevailing colour is bronze ; the golden colour is induced by a warm temperature of the water." My own observation does not coincide with this. I have known gold-fish exist in a terrace pond in Surrey for more than twelve years, exposed to every variation of temperature, the pond being fed by water from an open stream. It is true that some of these fish show a preponderance of dark colour, but others are clothed entirely in golden mail, and, if I recollect aright, a few individuals have undergone further change towards albinism, and become "silver-fish."

However, it is certain that, in their early stages of growth, gold-fish are indistinguishable from crucian carp, and that, as they approach adolescence, the dark skin becomes spangled with lustrous spots, which rapidly spread until the whole of the scales become one uniform covering of golden mail. It is this fairy metamorphosis which has made this otherwise insignificant creature become a considerable article of commerce. From immemorial times the Chinese have reared gold-fish as decorative objects in the chambers of rich people. From the Flowery Land they found their way westward with other luxuries. Groundless must be the tradition that they were first brought to France as an offering to Madame de Pompa-

dour, for they are known to have been kept in England in the seventeenth century, and the Pompadour was not born till the year 1721. At the present day they are reared in thousands for export by the Portuguese; yet it is not in rich men's palaces that they are to be chiefly found, but in humble village homes, fishmongers' shops, and in hotels a bowl of gold-fish is an object most commonly to be seen.

A bowl of gold-fish! What an innocent ornament to the parlour window-sill it seems, until one tries to realise the wants and natural habits of these creatures. Their true home is the ample pool or gently-flowing river, willow-fringed and with grateful cover of waving water-weeds. Food is abundant in the shape of succulent young shoots and larvæ of immeasurable variety. They have excellent appetites, and greatly appreciate the different flavours so liberally provided for them. Sunshine is a thing to be grateful for, and they love to bask in it for a while; but chiefly by reason that, when they have had enough, they can sink into the cool depths and sport with *Amaryllis* in the shade. Now contrast with this the abode which civilised man provides for the fishes which excite his admiration, and the fare with which he regales his captives. A clear glass bowl, with not a spray of weed or a friendly stone to break its monotony or afford a resting-place: such objects would interfere with the display which it is the sole function of these creatures to provide. Food is seldom given; by some good people who keep gold-fish it is forbidden, for it is apt to sully the water. Actually when I have remonstrated with kind-hearted women for starving their gold-fish, they have replied confidently, but vaguely, that they fed on the *animalculæ* in the water! Now I do not suppose it would be possible to devise a more heartless proceeding—that is, it would be heartless were it not utterly thoughtless and brainless—than a family to sit down three times a day and eat hearty meals in a room ornamented by a bowl of gold-fish. Round and round the hapless prisoners swim within their narrow,

dreary limits in vain instinctive quest of food. If it be true, as is believed from their superior proportion of brain, that these carp possess higher intelligence than others of the lower vertebrate animals, what must their feelings be towards the superior vertebrates who come and smack and guzzle and cackle in the presence of victims slowly dying of starvation?

Yes, dying of starvation! for although gold-fish, like others of the class, possess great power of abstinence, there must be a limit to that power. Nutriment is as essential to them as to other organisms; deprived of that, the vital spark must flicker out, after what degree of suffering we do not know. The cruelty of keeping live animals under these conditions is not one whit less real because it is founded on ignorance. I am the last to doubt the genuine desire of people in general to make their pets happy; but for Christ's gentle sake let them begin by taking the trouble to acquire the rudiments of knowledge in what the welfare of these pets consists!

In order to impress, if possible, the evil that we sometimes inflict upon our fellow-creatures out of sheer ignorance or want of imagination, let me describe something that came under my notice some years ago, involving suffering of an acute kind, little suspected by people who shudder at the idea of skinning eels alive.

It occurred at a city banquet on that scale which satisfies a healthy appetite by the end of the fish course, but which requires the successive acceptance or rejection of a long series of superfluous meats throughout the greater part of a summer evening, to the detriment alike of the complexions and constitutions of the feasters. Well, the table was beautifully decked with flowers, and a novel feature had been introduced into the decoration, whereof the caterer was not a little proud. Bowls of gold-fish stood at intervals *into each of which had been cunningly introduced an electric burner*, to show off the beauty of the captives. Probably the fish had been kept fasting ever since they had been shipped off from Portugal to Leadenhall

Market ; but that was not what filled me with horror and caused me to appeal to the master of the feast. Here were creatures which, like all fish, are fitted for existence only in a modified and diffused light, and which, like all Teleostean fish, possess no eyelids to screen off intrusive rays—here were these creatures, I say, confined in close proximity to an intense and concentrated light.

Imagine a human being shut into an empty chamber with an electric burner as long as himself ! Would it not be denounced as a torture of Carthaginian ingenuity ? At all events, the human creature could shut his eyes, which the fish could not do. It took me some time and trouble to explain this point to the constituted authority ; but, when I had succeeded, it is agreeable to record that the subaqueous lights were immediately turned out.

CHAPTER VIII

THE BARBEL AND THE GUDGEON

The Barbel—Distribution—Appearance—Habits—Angling for Barbel—The Gudgeon—Habits and Distribution—Angling for Gudgeon—Gudgeon as Food.

The Barbel (*Barbus vulgaris*)

FIN FORMULA (very variable).

Dorsal: 3 bony and 8 soft rays.

Rectoral: 1 bony and 16 soft rays.

Ventral: 2 bony and 7 or 8 soft rays.

Anal: 3 bony and 8 soft rays.

Caudal: 17 to 19 soft rays.

TEETH.

Pharyngeal, in two series.

THE well-defined genus of *Barbus* is the largest in the Carp Family, comprising nearly two hundred species from the tropical and temperate regions of the Eastern Hemisphere. On the American continent, strange to say, it is not represented. Naturalists have felt the inconvenience of including so many species in a single genus; but Dr. Günther has wisely refrained from indulging them by further subdivision, so consistent and uniform is the transition between the extreme forms. The mighty mahaseer (*Barbus mosal*) of the mountain rivers of India and the neighbouring countries, well known to anglers because of the noble sport it affords, is probably the largest of the genus, running to as much as 150 lb. in weight, with scales as large as the palm of one's hand; while certain other species never exceed two inches in length.

Of this great genus only one species inhabits British waters, namely, *Barbus vulgaris*, the common barbel, and even that is restricted to the valleys of the Thames, the Trent, and a few streams in the eastern counties. It does not occur in the Severn, nor has it been found in Scotland or Ireland, a distribution which coincides with the ancient geography of our own country, when the Thames and the Trent united with the Rhine in forming one great north-ward-flowing river. The common barbel still abounds in the Rhine, the Danube, and almost all the other rivers of Central Europe, and many European species are scarcely entitled to rank higher than as local variations from the type.

The body of the barbel is elongated, being in length fully five times as much as in depth, nearly cylindrical, and, except towards the tail, not laterally compressed, like most of the Carp Family outside the genus *Barbus*. The head is elongated, with a projecting fleshy upper lip and small eyes set high up and far back. Four barbels depend from the upper lip, two from the fore-part of the snout, and two from the angles of the mouth, and it is from these conspicuous appendages (one can scarcely call them ornaments) that it takes its English name. In all European languages this cyprinoid is "the bearded fish." The dorsal fin is short but high, and is carried jauntily erect, the bony ray being serrated on its posterior surface.

Distribution of the Barbel.

Appearance. The caudal fin is deeply emarginate or swallow-tailed, with even-pointed lobes; the pectoral and ventral fins are bold and well-shaped, and the anal fin is nearly as high as the dorsal, and is set very far back. Altogether this fish is well equipped with organs of propulsion, which enable him to make a grand fight when hooked. The scales are small; the lateral line is nearly straight, and running about mid-way between back and belly. The back is olive-green, melting into pale golden tints on the flanks; the cheeks are golden, the head and gill-covers being speckled with black, which sometimes extends to part of the

body ; but as a rule the body and fin colouring is uniform and without the mottle which distinguishes some other European species. The throat and belly are pure white. The barbel attains a considerable size in this country, but the multitude and diligence of anglers have rendered big fellows much more scarce than of yore. It is reported that they used to be taken in the Thames up to 18 lb. ; but the heaviest authenticated captures of recent years are two fish of 12 lb. 7 oz. and 12 lb. 1 oz. respectively, both taken in 1895 from the Newbury water of the Piscatorial Society, and now preserved in their collection. In warmer climates they grow to greater proportions : travellers tell of barbel in the Volga of 40 lb. and 50 lb. ; but then, the Volga is a long way off ! In England it was enacted under Queen Elizabeth that he who should take a barbel less than twelve inches in length should be fined twenty shillings and forfeit his gear.

In habits the barbel is a sociable fish, tending to collect in shoals, a propensity which anglers know how to increase by liberal ground-baiting. They are ground-feeders, and not very fastidious or cleanly ones. They grub in the mud for worms and larvæ, and rejoice in the most filthy substances discharged in sewage ; wherefore the activity of the Thames Conservancy Board and the County Councils in purifying the Thames must have deprived barbel of some of their favourite comestibles. From the great length of the intestine it has been inferred that much of their diet consists of vegetable growth.

Barbel spawn in May, and therefore get the full benefit of the close-time provided under Mr. Mundella's Act, from March 15th to June 16th. The female spawns in the shallower parts of running water, preparing a "redd" somewhat after the manner of salmon. After spawning, they repair to the swift shallows below weirs, and make a fine display rolling on the gravel and cleaning themselves.

In winter, like many other cyprinoid fish, they go through

a kind of semi-hibernation, lying inert in holes and deeps. Buckland describes a winter haunt of barbel which he found near Old Windsor. It was a very deep hole, under the root of a willow, where a large number of these fish lay together in a very inactive condition.

Barbel-fishers speak enthusiastically of their sport; and indeed it must be a fine one, having regard to the weight and strength of the fish, and the fineness of the tackle which it is necessary to employ for such a wary creature.

Angling for
Barbel.

The commonest mode of fishing is with a ledger, which is arranged as follows : A perforated bullet is threaded upon the running line and prevented from dropping within about three feet of the hook by a shot fixed at that distance. In strong water two bullets are required, which calls for a pretty strong rod, twelve feet long. A swivel between the running line and the gut is of much use in keeping the tackle clear. The bullet rests on the bottom, the hook streaming free along the gravel on three feet of medium salmon gut. The line must be kept taut, and the angler must strike directly he feels the fish bite.

Mr. Charles Wheeley, who probably has forgotten more about Thames fishing than most people have ever learnt, has a warning against using too fine gut. The barbel is a heavy, powerful fish, and, delighting as he does in strong, deep water, the sudden wrench when he is hooked strains the tackle in every part, and more fish break away thus than in any other kind of angling. It is necessary, therefore, to use nothing less trustworthy than medium salmon gut of the best, to disguise which from the barbel's educated eye it is well that the gut should be stained, if it were only to deprive it of its fatal glitter.

The other mode of fishing, which Mr. Wheeley pronounces far more amusing and effective than the ledger, is float-fishing. For rough, strong water in weir-runs the float is made of ten inches of large swan or pelican quill, thrust through a perforated pear-shaped cork, which is coated with paint. For smoother water a smaller float answers best, made in the same

fashion upon three or four inches of porcupine quill. In both cases it is important that it should be "a traveller"; that is, that it should not be tightly fixed to the line, which must be allowed to run freely through two rings upon the float, one upon the side of the cork, the other at the lower end of the quill, in order to ensure that the fish be effectually struck. The float is kept at the required position while fishing by a temporary stop, formed by giving the line above the float a couple of half-hitches round a small splinter of stick or piece of reed.

The line below the float must be weighted, so as to keep the bait tripping along the bottom as it is carried down stream, a knack which can only be acquired by practice. One great advantage of the float over the ledger is that it can be fished over a long swim. The ledger can only be dropped in the vicinity of the punt, whereas the float can be travelled from a great distance over the chosen spot where the ground-bait has been laid, and thus the risk of alarming the fish with the punt-pole and ryepecks is avoided.

The baits for barbel are few and simple. Lobworms, gentles, greaves, and cheese-paste—if these fail, Mr. Wheeley recommends cold mutton-fat. At times barbel take the live minnow, and Mr. Wheeley mentions the capture of a nine-pounder at Teddington on a black-beetle.

Ground-baiting is indispensable, and should be liberally carried out, so as to draw the fish to the appointed swim. If the water is of medium speed, a thousand or so of lobworms may be thrown in overnight, and a handful or two added in the morning before beginning to fish. But in swift, strong water the process is different. Clean strong clay, mixed with bran, is kneaded into lumps, with a hollow in each large enough to contain a handful of lobworms. The clay is then closed over the worms, and flung into the water, when the worms, which otherwise would be swept away at once, will escape gradually.

If your swim has been judiciously chosen and the weather

is favourable, sport on the morrow after ground-baiting may be fast and furious, and it behoves you to keep a cool head and a steady hand in order to avoid mishap. To hook a good fish and to lose him through broken tackle causes anguish intensified by shame, for at least seventy-five per cent. of breakages arise from the angler's fault—(I speak not of salmon in a Norwegian torrent where the fish cannot be followed). The deerstalker knows what remorse is when he sends away a good stag wounded ; not less keen, perhaps, is the humble barbel-fisher's bitterness of spirit when a bold fish escapes with a hook in his throat and a yard of salmon gut hanging from his lips. Honest Izaak Walton warned his pupil that the barbel "is so strong that he will often break both rod and line," and I am inclined to think that he avoided risk of disaster with this fish, by refraining from angling for it. In this case, as in that of the salmon, he wrote upon hearsay ; for how should he adventure forth against such barbel as the Thames contained in his day, without the furniture of a reel and running line ?

The properest tackle to use with a lobworm bait consists of one rather large hook (Nos. 10, 11, or 12), with a smaller hook tied on the gut about an inch above the first. The object of the smaller hook is to hold the worm straight, and prevent it doubling up into an unsightly bunch in strong water.

When barbel are well on the feed, it is not good to lose much time in playing the fish. "Hold your barbel as hard as you dare," is Mr. Wheeley's advice, "and get him out as soon as possible ; slip on another worm, and down with it ; if the fish are well on, it will most likely be taken as soon as it is on the bottom."*

Well, and what are you to do with your barbel when you have got him ? That is just the least satisfactory part of the performance. Were barbel a culinary prize, like salmon, the sport would be a noble one ; but most people account the fish

* *Coarse Fish*, by Charles H. Wheeley, p. 5. London : Lawrence & Bullen, 1897.

fit for nothing better than to feed pigs withal. Undoubtedly barbel are regularly eaten by the inhabitants of many parts of the Continent; but most writers report the flesh as very insipid. There is a good deal of evidence to the effect that the roe is actually deleterious to man, and even poisonous. Sir John Hawkins (1719-1789) went further, stating in a note to his edition of the *Compleat Angler* (1760) that one of his servants, who had eaten part of a barbel, but not the roe, "was seized with such a violent purging and vomiting as had like to have cost him his life." Dame Berners (1486) also utters a warning note. "The barbyll is a swete fysshe, but it is a quasy mete, and peryllous for mannys bodye. For comynly he gevyth an introduction to the febris (fevers); and yf he be eten rawe, he maye be cause of mannys dethe, whyche hath oft been seene." One is disposed to ask whether, in making this statement, she had in her mind her own precept, not "to wryte more than I knowe and haue prouyd."

Undoubtedly no man who values his health will be tempted to yield to an appetite for raw barbel, seeing that more than most fish is this one liable to harbour internal parasites of the most formidable description; and, on the whole, even when cooked in the most artistic manner, it is food after which few people will hanker. Nevertheless in old times barbel were frequently served at royal and other banquets.

The Gudgeon (*Gobio fluviatilis*)

FIN FORMULA.

Dorsal: 9 or 10 rays.

Pectoral: 15 rays.

Ventral: 8 rays.

Anal: 8 rays.

Caudal: 19 rays.

TEETH.

On the pharynx,
hooked at the
end, in two rows.

The genus *Gobio* consists of two species, both native to European waters. The British species, *Gobio fluviatilis*, is slightly the larger, although it seldom attains six inches in

length. Mr. Keene says that he has never caught one above ten inches in length ; * probably not, and most Thames anglers would read "six" for "ten." The English name, in which the *d* is intrusive and redundant, was formerly written "goione" and "gojone," Dame Berners spells it "gogen," an adaptation of the French *goujon*, which came from the Latin *gobionem*, accusative of *gobio*, an alternative form of *gobius*. Further back it cannot be traced, nor is the meaning known. The Greek form was *κωβιός*. We have retained the word "goby," but have assigned it to denote a totally different kind of fish of the *Cottidæ*, or Gurnard Family.

In build and general proportions the gudgeon is very similar to his larger relative, the barbel ; but he has only two wattles, instead of four, which hang from the upper lip at the corners of the mouth. The chief difference between the two fish, constituting their generic distinction, is the absence from the gudgeon's dorsal fin of the bony spine in that of the barbel. The body of the gudgeon is much elongated, and nearly cylindrical, being in length about four times and a half its depth. The mouth is horizontal, but inferior, covered with fleshy lips. The dorsal fin stands boldly erect halfway down the body ; the tail fin is symmetrically lobed ; the pectoral fin reaches as far back as in a line with the beginning of the dorsal ; and the ventral fins are nearly as long as the space between their base and the beginning of the anal fin. Altogether the gudgeon displays a very large fin surface in proportion to its bulk. The fins vary from a reddish to a yellowish hue, spotted with dark brown ; the back and sides, covered with rather large scales, vary from dark grey to brown or fawn, mottled with dark green ; the spots in some specimens tending to form a band along the lateral line. The under-parts are pearly-white.

The gudgeon loves clear running water, but it also inhabits lakes on the Continent. It is widely distributed through the

* *The Practical Fisherman*, p. 90.

Continent of Europe, inhabits most suitable waters in the southern and midland counties of England, is found in Ireland, but has not been reported from Scotland. It is intensely gregarious, moving in very large schools, and spawns in May and June. Its food consists of water insects and their larvæ, crustaceans, and worms.

The popularity of gudgeon-fishing, which is out of all proportion to the size and importance of the game, arises out of the free-biting habits of the fish, and the esteem in which it is reckoned on the table. Very delicate tackle is used, and the best bait is a well-scoured red worm, which must be kept close to the bottom by means of shot, supported by a light cork float. The art is a very simple one. First, find a gravelly reach about three feet deep, where gudgeon may be seen feeding. They are sometimes so thickly congregated in such places as almost to cover the bottom. A heavy rake with long teeth must then be used to scratch up the gravel withal ; the fish are attracted by the disturbance, and flock in to catch such small creatures as may be set swimming. Drop in your worm at the spot, and the hotter and brighter the day, the faster will be the sport. For gudgeon themselves, no reel nor running line is necessary ; nevertheless, it is prudent to have both, inasmuch as it sometimes happens that a lusty perch, chub, or other weighty fish may be hooked, and trouble come of it if line cannot be given.

Gudgeon are invaluable as baits for powerful fish of prey, but those who have experience of its gastronomic merits speak of it as delicate and delicious, resembling the smelt in flavour. Small though it be, it requires careful cleaning, being a gluttonous feeder and not fastidious in its diet. Experts direct that it be cut across the belly, not lengthwise ; the stomach and entrails to be pressed out with both thumbs. French cooks doubtless could impart a wrinkle or two as to cooking, for enormous numbers of gudgeon are taken from the Seine in the autumn, both by line and net.

CHAPTER IX

THE CARPS (continued)

The Roach—Appearance—Distribution—Habits—Angling for Roach—The Rudd—Distribution—The Chub—Distribution and Habits—Angling for Chub—The Dace—Distribution—Habits—Angling for Dace—The Minnow—Habits—Distribution—The Tench—Distribution and Habits—Tench as Food—Angling for Tench.

Eighth Sub-Family : **LEUCISCINA: THE WHITE FISH FAMILY**

THE eighth division of Dr. Günther's arrangement of the Carp Family contains a large number of genera, distributed widely through the northern temperate zone, and including thirty-five species indigenous to Europe and Asia, and forty to North America. In this group the dorsal fin is short, without a bony ray, and the teeth are ranged in a single or double series on the pharynx.

The Roach (*Leuciscus rutilus*)

FIN FORMULA (variable, being given differently by different observers).

Dorsal : 12 to 14 rays.

Pectoral : 16 or 17 rays.

Anal : 12 to 14 rays.

Ventral : 9 or 10 rays.

TEETH.

None on vomer or palate ; pharyngeal teeth conical or compressed, in a single or double series.

Certain creatures seem to be brought into being simply for the purpose of affording food for others, and such is the part

assigned to the roach in the scheme of Nature. Enormously prolific, the race maintains itself well in spite of the ravages of beasts, birds, and fishes of prey, and the more insidious attacks of external and internal parasites, to which this fish is peculiarly liable. Although in England the roach is not esteemed as an article of food, it is of great importance as a sporting fish, affording, more than any other, recreation to the angling clubs in our crowded industrial centres. Therefore let not him who can afford the supreme luxury of salmon-fishing despise the lowly roach, for just as the security of wealth depends upon the degree in which it is distributed, so the privileges of sport can only be maintained by the sympathy and co-operation of multitudes of its humbler disciples.

The name "roach" is one of those apparently simple words which baffle the philologist. One thing only is certain about it, to wit, that it is cognate with the name of another and wholly different fish, the ray, and the two names coalesce in the German *Roche*, which is used to denote both roach and ray. The origin and root meaning has been lost for ever.

The roach is quite a pretty fish, with a deeply compressed, but not ungraceful, body, and bold, well-shaped fins. The scales are large, numbering only forty-two or forty-three along the lateral line; they are rounded on the free edge, and glitter with a silvery lustre imparted by a substance called guanin in the epidermic cells. The exposed parts of the scales are also dotted with dark pigment granules. The general coloration is bluish or greenish on the back, silvery on the sides with bluish reflections, and silvery-white on the belly. The ventral and anal fins are stained red, the pectoral light grey, with a ruddy tinge in large individuals, the dorsal and caudal darker grey, more or less spotted with red, the caudal fin being deeply and evenly divided into two pointed lobes. The colour of the iris is generally a good rough distinction in fish, but there are as many and various estimates about that of the roach as there ever was about



Photo by P.D. Malloch

THE ROACH (*Leuciscus rutilus*)

$\frac{1}{2}$ Natural Size



Photo by Reinhold Thiele

THE GUDGEON (*Gobio fluviatilis*)

Life Size



the eyes of a favourite toast. Mr. Keene gives it as yellow, Mr. Seeley as silvery, while the latest authority, Mr. C. H. Wheeley, declares it is golden-red. Not having a specimen at hand to decide upon, I will not venture an opinion where high authorities are so much at variance.

Unlike the *Salmonidæ*, which part with their lustre at the approach of the spawning season, the roach, in common with other cyprinoid fish, increases in beauty at that time. It seldom exceeds 2 lb. in weight. Francis Francis regarded roach of that weight as mythical; and Frank Buckland, another practised roach-angler, pronounced all roach above that weight to be hybrids with the bream. Such hybrids, which occur pretty frequently both in England and Ireland, have sometimes received specific distinction, as the Pomeranian bream (*Abramis Leuckartii*), but the spurious origin of this fish is now pretty generally recognised. It may be distinguished at once from the roach by its whitish fins, and from its other parent by the tail fin, which is evenly lobed, and by the anal fin, which contains only from twelve to fourteen rays, instead of from twenty-six to thirty-one, as in that of the true bream.

Notwithstanding the value to be attached to the opinion of such past masters as Messrs. Francis and Buckland, I possess recent and unimpeachable evidence of true roach exceeding 2 lb. in weight. For instance, in October, 1902, the Rev. H. G. Veitch caught two roach, which were weighed by Mr. R. B. Marston, editor of the *Fishing Gazette*, and proved to be respectively 2 lb. $5\frac{3}{4}$ oz. and 2 lb. $4\frac{3}{4}$ oz. These fish were forwarded to Mr. Boulenger, for the ichthyological collection of the British Museum, who pronounced them to be "splendid specimens" of roach. A few days later the same angler forwarded two more, each weighing $2\frac{1}{4}$ lb. These fish were taken when netting coarse fish out of trout and grayling water near Salisbury. Mr. W. G. Fletcher took a roach with gentle in the Kennet, weighing 2 lb. $3\frac{1}{2}$ oz., which was exhibited on October 28th, 1902, at the weekly meeting of the Piscatorial Society.

The range of the roach is a wide one, for it occurs as a lake and river fish throughout Europe between the Alps and Scandinavia, and from the Danube to the waters of Ireland. In Scotland it is exceedingly local and irregular in distribution, and I am inclined to attribute its presence both in that country and in Ireland to the agency of man. For instance, in all the hundreds of lakes, great and small, in my own district of Galloway, I can only speak with certainty of the presence of roach in the two lakes at Castle Kennedy. Mr. Harvie Brown has recorded the introduction of this fish to the district of Moray in 1886 or 1887, when a stock was turned into the Loch of Spynie. Persons who own or manage waters containing more valuable fish ought resolutely to refuse to establish roach among them. The roach in the Castle Kennedy lochs above referred to have multiplied to such an extent that the trout-fishing, which was formerly excellent, has very much deteriorated. The roach are now netted out in cartloads, and applied as manure to the land.

The roach does not shrink from salt water, and is said to abound in parts of the Baltic. Possibly a marine life may have a beneficial effect upon its flesh, which has few apologists in this country, but in a dried state forms an important article of commerce in Russia. In the district of the Caspian Sea the annual take of roach was reckoned, thirty years ago, at between three and four hundred million, weighing upwards of 10,000 tons. The roe, both of roach and bream, is extensively used as caviare. Day describes the eggs as greenish, becoming red when boiled.

The roach feeds upon such animal diet as worms, water insects, molluscs, and spawn of other fish, but it also browses upon vegetable substances. In Britain the spawning season extends to near the end of June, but it is said to be earlier in more southern countries. At this, not less than at other times, roach are intensely gregarious, and so little fastidious about their company, as to associate freely with their

Habits.

cousins the rudd and bream, the results being frequently seen in hybrids. As above mentioned, like all the carps, roach are grievously afflicted with internal parasites. In June, 1902, Mr. Boulenger, on opening the visceral cavity of a roach taken in the Serpentine, found a disproportionately huge inmate in the shape of *Ligula simplissima*, the larval form of *Ligula digramma*, a flat band-like worm. The fish measured only five inches long and two and a half deep, while the parasite was seven inches long and half an inch broad.

Mr. Wheeley, than whom nobody is more competent to pronounce an opinion, declares that roach-fishing is "without doubt the most popular branch of coarse fishing." *
Angling for
Roach. He had expressed his meaning with greater precision had he said "fishing for coarse fish" instead of "coarse fishing," because, albeit the roach is numbered among what anglers class as coarse fish, great delicacy is required for success in the art of taking them, at least in such waters where much fishing has made them sly. Experts, it seems, are divided in opinion about the proper rod, some recommending the long or Lea rod, others the short Nottingham or Sheffield rod. The Lea rod, or roach pole, as it is called, is made of light cane, from sixteen to twenty-one feet long, with a single ring at the point, to which the line is made fast. The fisherman follows the float with his rod-point, keeping the line almost tight between the two. Every time he wants to land a fish, or even to bait his hook, he has to unship the butt; and, although it behoves one who is no roach-fisher to speak with deference of so high a mystery, I feel bound to say that the Nottingham style of fishing and apparatus seem far less likely to cause disappointment. To fish with very fine tackle without a reel and running line is to court disaster of a peculiarly bitter kind; for although a man may expect nothing more powerful than a roach of a pound weight, who shall warrant him against hooking a lusty perch, or a headstrong barbel?—either of which

* *Coarse Fish*, by C. H. Wheeley, p. 146.

will certainly carry away the tackle, unless there be means of giving him line.

It is for this and other reasons that Mr. Wheeley recommends a ten-foot rod with deal butt, cane centre, and solid heavy top of lancewood or greenheart. The significance of the last provision arises out of the peculiar style of Nottingham fishing, which, indeed, is a beautiful craft. It consists of allowing a light quill float to carry the bait a great distance down-stream, by means of a light-running winch and fine, greased running line. He who would "hit" a roach thirty yards away, must be equipped with a rod powerful enough in the top to strike that length of line instantaneously off the water. Some anglers insist upon using single horsehair next the hook; but there are master hands who reckon this an unnecessary refinement, and are satisfied with fine drawn, or even the finest undrawn, gut.

The favourite baits are gentles, paste, or boiled wheat; worms are effective at times; at others, roach may be taken by dapping on the surface with a grasshopper or large fly.

The Rudd (*Leuciscus erythrophthalmus*)

FINS.	TEETH.
<i>Dorsal</i> : 10 to 12 rays.	Pharyngeal, distinctly
<i>Anal</i> : 13 to 15 rays.	serrated. None on
<i>Pectoral</i> : 15 or 16 rays.	vomer or tongue.
<i>Ventral</i> : 9 or 10 rays.	
<i>Caudal</i> : 17 rays.	

The rudd is so like the roach in general appearance, size, and habits, that it often gets that name; but, besides a difference in coloration, there is one constant feature which distinguishes the two species. In the roach, a vertical line dropped from the front of the dorsal fin will intersect the ventral fin, or, at any rate, fall close behind it; whereas in the rudd a line so drawn will pass a considerable distance

behind it. Moreover, the rudd is deeper from back to belly than the roach. The name rudd, implying redness or ruddiness, has probably arisen from the beautiful red iris of this fish and the bright carmine of the lower fins, and sometimes of the dorsal. Moreover, the silvery tints of the roach are blended with golden ones in the rudd, though in a degree that varies much according to locality.

There are several well-marked Continental varieties, which it is not necessary to describe here. In range, the rudd corresponds very closely with its congener the roach, *Distribution*, although I am not aware of its having been found in Scotland. It is distributed generally over Europe and Asia Minor.

Angling for rudd is precisely similar to that for roach. As Richard Franck pompously put it two hundred and fifty years ago, "Whilst we paraphrase and discourse the roach, we but decipher and interpret the rudd; since Nature's laws are alike to both, for both have but one fate and period, though of different complexion of fin." Slapton Ley, in the Norfolk Broads, is reputed the best station for the rudd fisher, where these fish readily take the fly in the sandy shallows. "I am almost afraid," says Mr. Manley, "to say how many score I have taken there in a few hours with a single-handed fly-rod and common red palmer fly, but remember, with a small piece of white kid glove, the size of a gentle, flying on the head of the hook."

The Chub (*Leuciscus cephalus*)

FIN FORMULA.	TEETH.
<i>Dorsal</i> : 11 rays.	Pharyngeal, in two rows
<i>Anal</i> : 11 or 12 rays.	of three and five
<i>Pectoral</i> : 14 to 16 rays.	each; strong, long,
<i>Ventral</i> : 10 rays.	compressed, and
<i>Caudal</i> : 19 rays.	hooked.

Like all British cyprinoid fish, the chub is a disappointing fish from a culinary point of view. He rejoices in more

English synonyms than any other inhabitant of our waters, as though men would persuade themselves that so substantial a creature, disguised under a tempting *alias*, might make a prettier dish. But it is all of no avail; nobody has had a good word for this fish on the table since Izaak Walton made Venator exclaim, after sampling the big chub with the white spot on its tail, "Trust me, 'tis as good meat as ever I tasted."

Most people who have tried it continue to be of Venator's earlier opinion. "Oh, sir! a chub is the worst fish that swims; I hoped for a trout to my dinner." Even the French can make nothing of him, and dub him *le vilain* or *le vilain testard*. More's the pity, for the chub shows more sport than most of his kindred, reaches a heavy weight, and rises well to the artificial fly.

Two features mainly distinguish the chub—its plump, thick body, and its heavy head. From the first of these characteristics has come the name "chub"—that which is plump; from the second has come the older English name "chevin," from the old French *cheviniau* (modern French *chevanne*), a derivative of *chef*, the head, and equivalent to the Italian name for this fish—*capitone*.

In colour the chub is dark greenish or bluish on the back, bright silvery on the sides, sometimes tinged with brassy hues in large specimens. The skin is covered with large and strong scales, those above the lateral line measuring one-half more in diameter than the eye. As in all cyprinoid fish, there is a curious spine-like scale situated just over the insertion of each ventral fin. In the chub, this scale, like the ventral and anal fins, is coloured bright red; the pectoral fins are greenish, the dorsal and caudal very dark grey, ruddy at the base. The iris is golden, with green spots. The chub grows to a larger size than any other of the British white fish, except the bream. It is often taken weighing from 2 lb. to 3 lb., rarely as much as 5 lb. or 6 lb. Mr.

Cholmondeley-Pennell has put the following measurements on record :

Weight,	5 lb.	$5\frac{1}{4}$ oz.	; length,	21 in.
„	6 lb.	$2\frac{1}{2}$ oz.	; „	22 in.
„	7 lb.	$0\frac{1}{2}$ oz.	; „	23 in.

In the autumn of 1902 a fine chub was killed in the Eden, Cumberland, by Mr. W. Corless, of Wigan. The dimensions of this fish were as follows: Length, 24 in.; girth, 15 in.; weight, 6 lb. 3 oz. From Austrian waters chub of heavier weights than these are reported.

The chub is widely distributed over the temperate zone in Europe and Asia Minor, but does not extend far into Scotland.
Distribution and habits. In some tracts, notably the Spanish peninsula and Dalmatia, it has assumed varietal forms so constant as, in the opinion of some naturalists, to constitute separate species. Unlike many cyprinoid fish, it is impatient of pollution, and loves clear running water and a gravelly or sandy bottom. In no British river is it more abundant than in the Eden of Cumberland, where it is known as the skelly,* and regarded as a mischievous kind of vermin because of the destruction it executes upon the ova and young of salmon and trout. It is of a more actively predaceous habit than any other British cyprinoid fish, for although it consumes large quantities of vegetable food in summer, it is practically omnivorous. Worms, flies, trout and salmon spawn, small fish, frogs, and even mice come not amiss to the chub's capacious maw. There is, therefore, more than one reason for the owners of waters containing trout to detest the worthless chub, which not only destroys great quantities of spawn and fry, but appropriates a vast deal of the provender which would otherwise go to support better fish. In the Cumberland Eden is practised a device for getting rid of chub, which is known as "fuddling skellies."

* This term is also applied in the English Lake District to a very different fish, *Coregonus clupeoides*, one of the lacustrine *Salmonidæ*.

I have never seen it in operation, but I have been assured that it is exceedingly effective. The recipe is as follows : Boil $1\frac{1}{2}$ lb. of rice until *rather* soft (not so much so as to cause it to adhere), let it cool, then add $1\frac{1}{2}$ lb. of flour, 1 oz. of *Cocculus Indicus*, and crumble up with the whole a threepenny loaf of stale bread. Mix all together with the hands, and fling it in pieces about the size of swan-shot into the haunts of chub and other coarse fish. These will eat it—though trout, it is said, will not—and presently float up in a disgraceful state of intoxication, when they may be scooped out with a landing-net. Chub gather into companies in the spawning season, which in Britain takes place in May, and deposit their ova in gravelly places. Were the chub a more valuable prize, angling for him ^{Angling for} would be a very exciting sport, for he is a wary ^{Chub.} fellow, and must be approached by stealth and with fine tackle, which by his strength and weight he is able to test to the uttermost. He takes both fly and minnow, as trout-fishers know to their chagrin. Many a time is the dry-fly fisher deceived by a fish rising seductively in a difficult place under the trailing sprays of a willow. With skilful sidelong cast he manages to deliver his fly neatly a yard or more above the spot ; it lights like gossamer on the surface and travels down, airily cocked in irresistible fashion. A modest dimple on the placid current—the line tightens bravely, and the reel spins merrily as the fish makes a strong, deep rush towards the pollard root. The angler's heart is in his mouth, for this feels like a trout of 3 lb. at the least. Next moment an angry monosyllable disturbs the serene air ; the rush is checked and spent, and a great chub comes lumbering to the surface, soon to be dragged without ceremony to the net, for summer chub make but a poor fight, and no trout-fisher would soil his basket with such slimy quarry.

Quick sport may be had with chub in weir-streams and swift, shallow water during June and July ; but the fish are not at their best till September. In that month they seek the

deeper water ; but, if the weather be warm, large ones may be taken by casting from a boat under the boughs of trees on the river bank. A large red palmer, or a grilse fly, will be found as attractive as anything else. The fish at that season are in the highest condition of which they are capable ; firm and bright as a salmon-trout, and fighting most creditably for freedom.

Of the other methods of taking chub, the chief are the tight float and the travelling float, as has been described under the heads of barbel and roach. Orthodox chub-fishing is of the same nature as roach-fishing, only more so—that is, you may use rather stronger tackle, and travel your float further off in “long-corking.” To do this successfully requires a light, strong silken line, well greased, to make it float flexibly, with a mixture of Aspinall’s green enamel and vaseline. As for baits, there is positively no limit to the variety of successful ones ; not even that of edibility, for Mr. Wheeley records the capture of a mighty chub with a gummy chestnut bud, and for winter fishing he recommends “pith and brains”—that is, a judicious ground-baiting with bullock’s brains, following by the presentation as bait of a piece of the “pith,” or spinal cord of the animal. Lob-worms, shrimps, bread, cheese, mutton-fat, minnows, and macaroni—all these are greedily taken when the fish are on the feed. In the Thames, where picnic parties do greatly abound, chub have acquired a passion for cherries, and Mr. Wheeley declares that a large white-heart or Bigaroon generally proves irresistible. He mentions an incident curiously illustrating the peculiar habits of this fish. A large damson-tree overhung the river near Pangbourne. One windy day, when the fruit was ripe, an angler happened that way, and noticed a fine company of chub greedily gulping the damsons blown off the tree into the water. He took the hint, and, using damsons as bait, made a very large catch.

The Dace (*Leuciscus vulgaris*)

FINS.

Dorsal : 9 or 10 rays.

Anal : 10 or 11 rays.

Ventral : 9 or 10 rays.

Pectoral : 15 to 17 rays.

Caudal : 19 rays.

TEETH.

Pharyngeal only, in two rows on each side of the throat, containing respectively 3 and 5 teeth.

The adult dace is a much more elegant fish than the chub, although in the juvenile stages the two fish so closely resemble each other as to puzzle some people about their identity. The surest distinction between these kindred species is their colour. The sides of the dace reflect none but silvery or steely tints ; the tail fin is not darker than the back, as in the chub, neither are the ventral and anal fins red as in that fish, but greenish, the ventral fins having only a faint roseate tinge. The back of the dace is dark olive, but changes to silver on the sides much sooner than in the chub.

The name "dace" is explained by philologists to be the mutilated remains of "darce," which is the form given to it in *Babees' Book* (fifteenth century). The original sound is more nearly preserved in the English synonyms "dare" and "dart." It represents the old French *dars* or *darz*, from the Low Latin *dardus*, a dart or javelin. The assumption is that the fish earned the title from its swift, darting movements ; although it must be owned that it is quite as applicable, on that ground, to many other fish.

The small, rounded head, less than one-fifth of the whole length, the elongated yet graceful body, the brilliant eye, with its yellow iris shot with red and green, the glittering silver mail and finely-shaped fins, combine to make the dace the most comely and distinguished-looking of English carps. The tail fin is a powerful, symmetrical propeller, deeply cleft into two pointed lobes.

The dace prefers streams with a gentle current, and with plenty of gravelly shallows, but it is also found in lakes on the

Continent. Its range nearly coincides with that of the roach, but it is not native to Scottish or Irish waters. Like all the family, it is subject to local variations, which have been distinguished as species by some naturalists. *Distribution.* One of these varieties, named the graining, and formerly known to ichthyologists as *Leuciscus lancastriensis*, inhabits the Mersey, the Warwickshire Leam, and some of the Swiss lakes. The so-called dobule roach, *Leuciscus dobula* of Yarrell, is probably no more than a young dace.

In habits, food, time of spawning, and other respects, the dace corresponds pretty closely to the roach, save that it is more addicted to surface-feeding, and is more at home in running water than in still. *Habits.* It is nowhere so abundant in Britain as the chub and roach ; nor can it be considered wise to introduce it into those waters where it does not already exist, for as an article of food it holds a place not much, if at all, higher than the other silvery carps.

Dace may be taken by all the means and tackle used in roach-fishing ; but, having regard to the worthlessness of the fish when caught and their moderate size, artificial fly-fishing is the only method worth the attention of those who fish for sport. *Angling for Dace.* Of course in match-fishing, where the object is to weigh in as many fish as possible, other motives must be taken into account, and bait may be resorted to.

People of means ample enough to secure for themselves good salmon and trout fishing are apt to despise the competitive angler ; but it requires only a slight knowledge of the conditions of life in crowded industrial districts to enable one to realise the value of waterside recreation for hard-working men. Coarse fish are such a poor prize in themselves that one should not grudge their captors the additional zest of competition. But from the standpoint of pure sport, fly-fishing is the right way to take dace ; and may be practised best when the fish move on to the shallows on serene summer evenings. It takes a quick hand to score

success, for the dace is exceedingly nimble on the rise, and must be struck on the instant. Most of the fish taken will run from one-third to half a pound; but occasionally one of a pound weight appears, which may be reckoned the maximum size of this lively carp.

The Minnow (*Leuciscus phoxinus*)

FINS.	TEETH.
<i>Dorsal</i> : 9 or 10 rays.	All pharyngeal, hooked,
<i>Anal</i> : 9 or 10 rays.	in two series, 4 or 5
<i>Ventral</i> : 8 to 10 rays.	and 2.
<i>Pectoral</i> : 16 or 17 rays.	
<i>Caudal</i> : 19 rays.	

The smallest of all British cyprinoid fish is the minnow, seldom exceeding three inches in length, although Dr. Günther states that it grows to a "a length of seven inches in favourable localities." It rejoices in a larger choice of English names than any fish except the chub, and the etymology of that in most general use—the literary name, in short—is rather complex. There is no doubt, however, that the root is *min*, small. In Scotland the popular name remains "minnin," the same as it was in the fourteenth century. We read in Barbour's famous poem, *The Brus* (c. 1375), that Lord James Douglas acted as caterer to the King of Scots during his wandering in the Highland hills after the battle of Methven.

Bot worthy James of Douglas
 Ay travaland and besy was
 For to purchas the ladyis met,*
 And it on mony wis † wald get.
 For quhile ‡ he venesoun tham brocht,
 And with his handis quhile ‡ he wrocht
 Gynnys § to tak geddis || and salmounis,
 Troutis, elis, ¶ and als menounis.**

* Meat, food. † In many wise, ways. ‡ Sometimes. § Snares. || Geds, pike. ¶ Eels. ** Minnows.

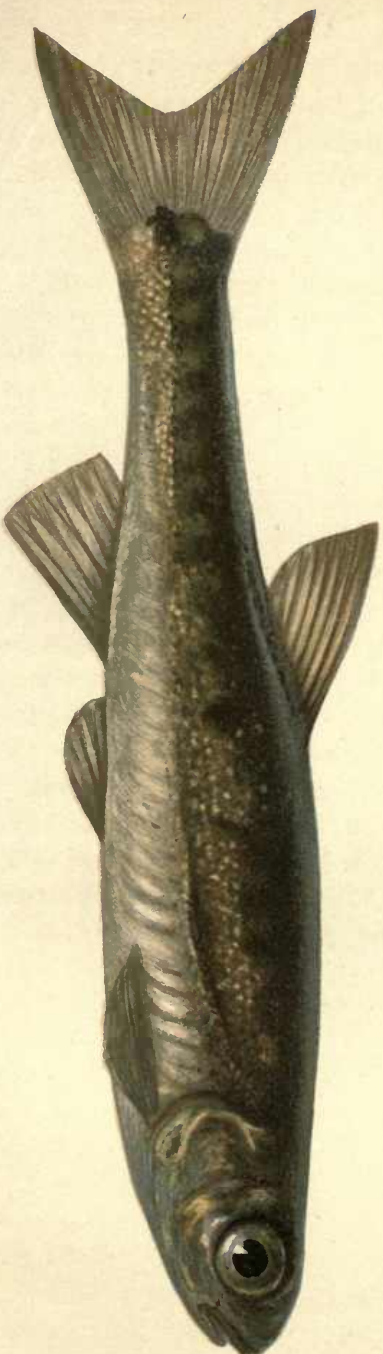
Photo by P.D. Malloch



THE DACE (*Leuciscus vulgaris*)

about $\frac{3}{4}$ Natural Size

Photo by P.D. Malloch



THE MINNOW (*Leuciscus phoxinus*)

about 4 times Natural Size

The minnow is one of the most familiarly known inhabitants of our waters, for it abounds in most parts of England and Southern Scotland, although, as will be noted presently, there are some singular gaps in its range. Of the thousands of people who are accustomed to see these little fish swarming in clear, swift streams, many would be surprised to learn that they are to be numbered among the carps, so widely do they differ in habit and action from the heavier members of that great family, and in colour from the rest of the silvery genus *Leuciscus*.

In length the minnow measures five or six times its own depth, and its thickness is about two-thirds or three-fourths of its depth; consequently it has a plump, muscular appearance, which, combined with its elongated form, agrees well with its incessant activity, for minnows may very seldom be detected at rest. The snout is rounded and arched over a small, but exceedingly serviceable, mouth. The body is covered with delicate scales, so small that eighty or ninety of these may be counted along the lateral line, or about twice as many as in the roach. The colour varies, not only with the season, but from day to day, and even from hour to hour, the prospect of a good meal being quite enough to cause a marked change in the complexion of this little fish. The mechanism of this colour variation has been explained to consist in two layers of pigment cells, one above the other in the skin. The outer layer has star-shaped cells containing black pigment, which contract on occasion and allow the light to be reflected from a yellow pigment in the inner layer of cells. Excitement, therefore, which betrays itself in the human countenance by a flush of rose-colour, changes the aspect of the minnow from grey to gold. In spawning time, when the males are brightest, they may be described as dark olive on the back, with a black band or line extending from head to tail, sometimes broken into blotches or spots. Metallic lights gleam through

the greenish-yellow tints on the sides ; the iris is golden or red ; the throat is black, the breast, pectoral fins, and corners of the mouth are red, and the belly is white. But all this is subject to variation in individuals, and the artist who proposes to represent the minnow faithfully must wield a swift brush, for all these gay tints disappear soon after death. I have seen it stated that, when spawning, minnows emit a phosphorescent glow at night, but I am unable to confirm this from observation, and may be permitted to doubt it.

There is no more sociable fish than the minnow ; he is never to be found save in company with his kind. No

Habits. edible substance comes amiss to his unflagging appetite ; if the morsel is too large for a single minnow to tackle, his companions gather thickly round, and soon demolish it among them. In this manner they dispose of the dead bodies of their own kind. Spawning in Britain is usually accomplished in May or June, when the skin of the head and back develops warty tubercles, which disappear immediately after the operation. The ova number from 700 to 1,000 in well-grown females, and are shed among the gravel in shallow water, where they sometimes form coherent masses measuring as much as eight inches by two.

The minnow is found in suitable waters in nearly all parts of Europe, except the Spanish peninsula, but it is said not to be indigenous to Ireland, though it
Distribution. has become established in some parts of that island as the result of acclimatisation. In Scotland it is locally abundant, but it is completely absent from certain watersheds. Messrs. Harvie Brown and Buckland do not mention it in their work on the fauna of the Moray Basin. Though it is plentiful in the streams of Eastern Galloway, especially in the Cree, which divides Kirkcudbright from Wigtownshire, it is not found elsewhere in Scotland,

except where it has been introduced artificially in the neighbourhood of Whithorn.

I have eaten minnows, but it was many, many years ago, as an Eton boy—a truly omnivorous animal—and I am not impatient to repeat the experiment. Howbeit the old writers commend them; Izaak Walton giving elaborate instructions how to make a minnow-tansy, wherein the fish being gutted, but not washed, must be fried with yolk of eggs, cowslips, primrose, and tansy. William of Wykeham gave a great banquet at Winchester to Richard II. and Queen Anne, and among the fish served were seven gallons of minnows, costing 11s. 8d. Frank Buckland, who quotes this instance, speaks well of minnows fried as whitebait or pickled, but persons so treating them should insist upon their being thoroughly cooked, forasmuch as, in common with all the carps, these little fish are infested with dangerous internal parasites.

Notwithstanding the small culinary repute accorded to minnows in modern days, they are of a high economic value as food for larger fish, and may be safely and profitably introduced into all streams where they are not native. The easiest way to take them is with a shallow net attached to an iron hoop two or three feet in diameter, weighted by a bullet in the middle. A scrap of red cloth may be tied within the net to attract them; and the net must be suspended from a pole, and lowered into the water where minnows abound. They will scatter in alarm, but will soon return, and, inspired by irresistible curiosity, will gather thickly over the net, minutely inspecting every knot and the bit of red cloth. As soon as they are busy discussing the novelty and testing its edible qualities, raise the pole quickly and you secure the whole company.

The Tench (*Tinca vulgaris*)

FINS.

Dorsal : 10 to 12 rays.*Anal* : 9 or 10 rays.*Ventral* : 10 or 11 rays.*Pectoral* : 15 to 17 rays.

TEETH.

Pharyngeal, wedge-shaped, slightly hooked at the ends, in a single series, five on the left side of the throat, four or five on the other.

In the sub-family or group *Leuciscina*, whereof so many genera and species bear such a close external resemblance to each other, the tench stands out distinct, to be confused with no other fish. It is a genus of but a single species, *Tinca vulgaris*, whereof the most obvious characteristic are the exceedingly small scales, numbering more than one hundred along the lateral line, deeply embedded in the dark olive epithelium of the skin, through which they glisten like myriads of golden dots. The secretion of mucus is exceedingly abundant, rendering the fish as slippery as any eel. The tench is also distinguished from the rest of this group by a short barbule at each angle of the mouth. A variety known as the golden tench, said to have originated in Germany, and to have been introduced into Britain during the last century, is described as an exceedingly handsome fish. The skin is of a rich orange colour, irregularly blotched with the normal colour of the species. This change of colour must be attributed to incipient albinism, such as gives distinction to the gold-fish (*Cyprinus auratus*). In 1878 Mr. Higford Burr had a great number of them, the offspring of a single pair, which had bred freely in one of his ponds at Aldermaston Park, near Reading. The ordinary colouring of the tench is a rich olive green or brown, shaded into light grey on the belly. The back seems almost black, and the fins vary from brown to violet-grey. The iris is red, ringed or blended with yellow. The caudal fin is very broad and powerful, rounded at the angles and not divided into lobes. The other fins are all very

short—that is, the bases occupy but a short space on the body ; but they are high or deep in comparison with their breadth, with bold rounded outlines. The ventral fins of the male, in young fish identical with those of the female, become modified with age into a concave shape, the first ray being greatly thickened. The bones and muscles attached to the base of these fins in the male are so fashioned as to enable the fish to draw in the abdomen in a peculiar manner. This has been explained as a means to facilitate the discharge of the milt, which other fish hasten by rubbing themselves on stones or stakes—objects not often to be found on the soft, muddy bottoms usually frequented by tench.

Tench have no liking for swift waters. A pond or disused clay pit, with a soft bottom where they can bury themselves in cold weather, is what they dearly Distribution and habits. love. When that cannot be their lot, then are they fain to put up with such rivers as the Thames, where there are long and deep sluggish reaches ; but they hold strongly the belief that all running water is water running to waste. They are believed not to be indigenous to Britain, although firmly established in both England and Ireland ; possibly also in Scotland, though I have not met with them there. They are common throughout Central and Southern Europe in all suitable waters. They are seldom taken in England of more than 3 lb. or 4 lb. in weight, although pisciculturists in Germany rear them to double those dimensions in their carp ponds. There is a very circumstantial account in Daniel's *Rural Sports* of a very large tench taken from a piece of water which had been made the receptacle of waste wood and rubbish for many years. Orders having been given to have this pond cleared out, nobody expected to find in it any fish, except perhaps a few eels ; but to the general surprise, when the water was run off some 400 tench, and as many perch, were laid dry. Then, in a hole under

some roots, a large animal was seen to move, which the workmen took to be an otter. Forming a ring they tried to bolt him, when the creature was found to be an enormous tench, wedged into a hole, the shape of which he had grown to fit. The dimensions of this notable fish are recorded with so much precision that the evidence about it cannot be set aside. They are as follows: length from eye to outer margin of tail fin 33 inches, circumference 27 inches, weight 11 lb. 9½ oz.

The tench is very prolific: the ova are greenish in colour, and the ovary of a female weighing 3½ lb. has been found to contain no less than 297,000 eggs. It spawns in May and June, when the males abandon their leisurely and sedentary habits, appearing in the character of dashing lovers, racing after the females so impetuously as sometimes to drive them ashore.* It has been observed that every female is followed by two or more males. The spawn is deposited chiefly on water weeds—the *Potamogeton*, for instance, which is sometimes locally called “tench weed.”

The food of the tench is of the same character as that of the carp, consisting both of animal and vegetable substances, but probably it is not in the habit of preying upon other fish; for, notwithstanding its great spread of fins and powerful build, it is an animal of leisurely movement and sluggish disposition. In winter it buries itself in the mud, and lies low till the return of warmth in spring.

Folklore has gathered fondly round this fish, and many wonderful stories have been believed about its healing virtues, not only affecting other fish, but men also. It is wearisome, and even humiliating, to repeat such idle tales. Their worth may be gauged by a perusal of what Izaak Walton, shrewd enough in so many respects, reports of them.

* I speak not from personal observation. Mr. J. H. Keene states that he has witnessed “repeatedly” such a scene as this (*The Practical Fisherman*, p. 85).

After quoting without question the authority of Rondeletius for the cure of a sick man at Rome by the application of a tench to his feet, he cites as among the sacred remedies known to the Jews the prescription for swallowing live lice as "a certain cure for the yellow jaundice. This, and many other medicines, were discovered by them, or by revelation ; for, doubtless, we attained them not by study."

Born a goddess, Dulness never dies ;

and it is certainly discouraging to find that Mr. J. H. Keene, to whose *Practical Fisherman* I owe much interesting information, makes the following amazing statement, savouring more of the sixteenth than the nineteenth century :—

"I myself know of a complete cure of a bad case of jaundice by the agency of a tench. The fish was split open and the inside and backbone taken out ; it was then tied over the region of the liver, and in three days the cure was almost perfect. The tench was found dyed a complete greenish-yellow hue on being taken off."

Quite so, and the effect would have been just as satisfactory to the patient, provided he had equal faith in the means, had an old shoe or a back number of the *Lancet* been used instead of a tench.

Mr. Keene also lends his support, as a practical angler, to the groundless statement that pike, out of gratitude, will not attack tench, and that it is useless to offer that fish as a bait. Now, the discredit which is inseparable from silly stories such as these, rightly extends to those who repeat them, and it is high time, for the honour of the fisherman's craft, that they should be stopped. It may be impossible to disprove the medicinal properties of tench, for it is proverbially difficult to prove a negative ; but any man may convince himself that pike will seize small tench when offered on spinning tackle. The Rev. W. Houghton states that he has occasionally killed pike by trolling with a small

tench, and quotes Mr. Masefield, of Ellerton, as having done so frequently ;* but doubtless a more brilliant fish would attract more pike.

The flesh of the tench is very variously reported on by different writers. Ausonius, writing in the fourth century, is perhaps the earliest reference. In his tenth idyl, treating of the Moselle, this poet wrote :—

Quis non et virides vulgi solatia tincas
Norit, et alburnos prædam puerilibus hamis,
Stridentesque focis obsonia plebis alausas.†

This is neither praise nor blame. Richard Franck, who had a fine contempt for coarse fish in general, is more emphatic, observing of the tench, "Let me tell you he's a delicious morsel." Others condemn the meat as insufferably muddy in flavour ; but, no doubt, this varies according to the seasonal condition of the fish ; and, having regard to its usual stagnant haunts, where the mud is often deep and fetid, the tench probably improves for the table if submitted to a period of purification and feeding in a clean stew-pond. For myself, I can testify that it is the only one of the Carp Family that I have ever eaten with relish. That was in the month of May, at the wayside tavern of Meung-sur-Loire, a village made illustrious for ever as the scene chosen by Dumas to introduce the immortal d'Artagnan to his million readers. Arriving there from Orléans near midday on our bicycles, we were served with an excellent déjeuner, whereof the only features that remain bright in memory are the good red wine and a dish of small tenches delicately fried in oil.

Except this fleeting interview with the tench on the banks of the Loire, my personal acquaintance with this fish is limited

* *British Fresh-water Fishes*, p. 49 (1895).

† "Who does not know the green tenches, a boon to the common folk ? and the bleak, a prey for schoolboys' hooks ? and shad, hissing on the hearths, fish-fare for the people ?"

to his behaviour in an aquarium, whereof I was the sedulous guardian in days long since gone by. As a sporting fish he ^{Angling} has never tightened line of mine ; I rely, therefore, ^{for Tench.} upon Mr. Wheeley as a guide to the art of taking him with hook and line.

The method seems to be much the same as in fishing for carp, either with the float, in the manner known as "tight corking"—that is, with a short straight line from the rod-point to the float—or with the ledger. If tench are about and in the humour to feed, the sport is often fast and very brisk ; for the tench will not yield up his loafing, leisurely existence without a stiff fight, and is a powerful swimmer when put to it. But tench may be about, yet nothing be found to induce them to take the bait. "You may fish," says Mr. Wheeley, "for, days, and not get a single tench ; then they will suddenly feed and you may fill your basket in no time." Hot weather is best for this sport, under the shade of trees. The likeliest baits are the same as those recommended for carp.

CHAPTER X

THE BREAMS, THE BLEAK, AND THE LOACHES

The Bream—Habits—Angling for Bream—The White Bream, or Breamflat
—The Bleak—The Uses of Bleak—The Loach—The Spined Loach.

Twelfth Sub-Family : **ABRAMIDINA: THE BREAM GROUP**

THE twelfth group of the Carp Family is distinguished by the prolongation of the base of the anal fin, and the lateral compression of the abdomen, or part thereof, into a narrow edge.

The Bream (*Abramis brama*)

FINS.	TEETH.
<i>Dorsal</i> : 12 rays.	Pharyngeal, notched at the free ends, 5 on each side, in a single row.
<i>Anal</i> : 26 to 31 rays.	
<i>Ventral</i> : 10 rays.	
<i>Pectoral</i> : 16 rays.	

The bream is easily distinguished from other carps by the remarkable depth of the body, which is severely compressed laterally, and measures in length only about three times its depth. The abdomen is flattened into an acute ridge or edge, finishing off a peculiar configuration, which suggests that the animal owes it to his powerful fins that he has maintained a vertical position, and has not turned over on one side and so become a flat-fish. The dorsal fin, set in the middle of the back, is very short and high, acutely pointed, the first ray

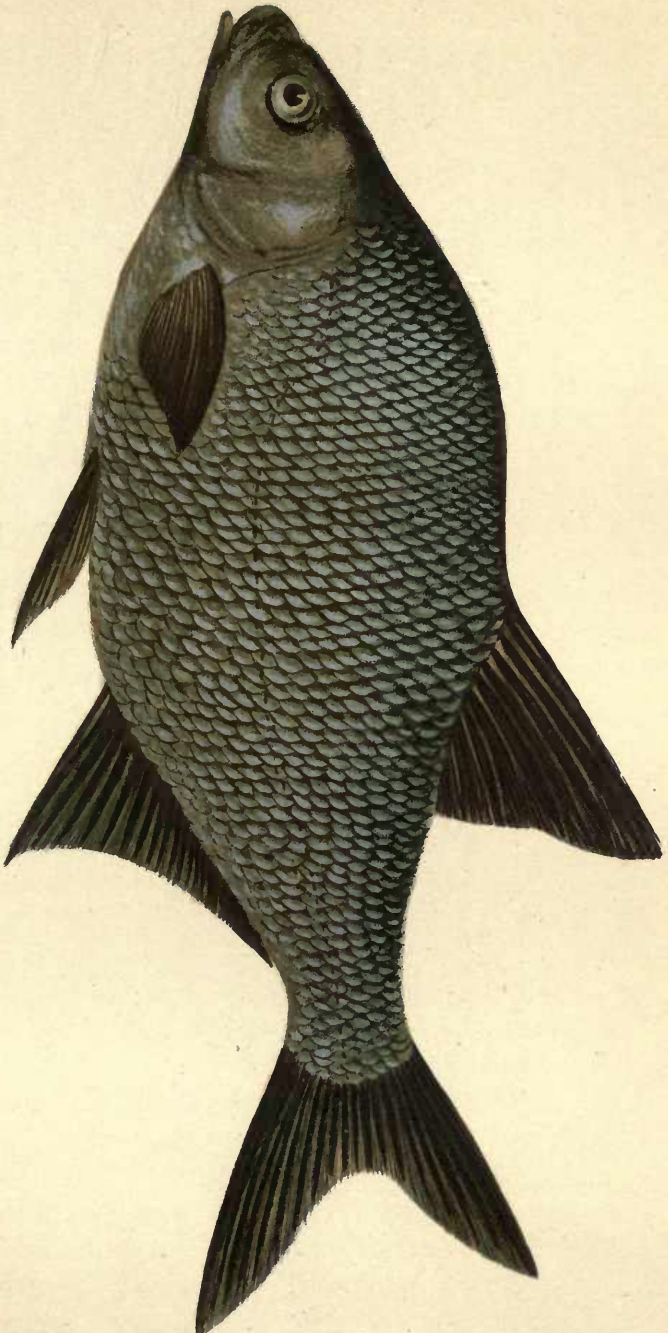


Photo by Kenneth Thiele

THE BREAM (*Abramis brama*)

$\frac{2}{3}$ Natural Size

being four times the length of the last. Conversely, the base of the anal fin is much greater than its height, occupying one-fourth of the entire length of the body. The tail fin is deeply divided into two irregular lobes, both acutely pointed, the lower lobe being half as long again as the upper.

The body scales are rather large, numbering 51 to 57 along the lateral line, and are very thickly coated with slime. The colour of the back is very dark olive. In young fish the sides are silvery white, but this becomes tinged with brassy, and even bronzy, hues in older fish. The fins are of inky hue, tinged with blue; the throat ruddy, the belly white, and the iris golden yellow.

The name "bream" has been traced to the same original as "bass" (see page 66), which was once written "barse" and "brasse," and may be recognised in the Old French *breame* (now *brème*), the old High German *Brahsema*, the Middle High German *Brahsem*, and the German *Brassen*, all applied to the fish which are known as "bream." It has no known connection with the ἀβραμῖς—*abramis*—of Oppian's *Halieutics*, which was a sea fish, although Cuvier, attracted by similarity of sound, chose that name to designate the genus.

The bream is as much at home in rivers as in lakes, and is found in most parts of temperate Europe north of the Alps and Pyrenees. Although not uncommon in Ireland, it is absent from Scotland. It is said to enter the salt water of the Baltic. Bream probably are to be seen in the Norfolk Broads in

greater numbers than elsewhere in England, but they
Habits. abound in the Shropshire meres also, and in some rivers of the Midlands, notably the Ouse.

They swim in large shoals, and are supposed to be under the leadership of one of their clan. They spawn in May or June, when the heads of the males become temporarily covered with warty tubercles and the scales feel rough to the touch. The eggs are yellow, 200,000 or 300,000 in a moderately-sized female, and are left hanging upon water weeds. Like

carp and tench, bream come to the surface on warm nights and may be heard smacking their fleshy lips. Their food is vegetarian in great part, but they also devour worms and insects.

Nowadays in England the flesh of bream is of rather less than moderate repute, though some people maintain it to be excellent, but, like that of all the carp tribe, it is very perishable, and ought to be dealt with speedily. The fish changes colour soon after death, showing red stains, indicating incipient decomposition ; add to this the extraordinary amount of slime secreted from the mucus canals of the head and body, spread thence all over the skin, and you have an object far from appetising. Nevertheless, enormous quantities of bream, both of this and other species, are consumed on the Continent, especially in Russia and Eastern Europe.

He who would take bream with rod and line must go warily to work, neither showing himself incautiously nor making any noise, for they have sharp eyes and quick ears, and, although habitually slow in movement, dash off in a prodigious hurry when alarmed. They are bold biters, and he who falls in with a shoal of large bream is not unlikely to have a busy time with them, unless they have become wary from much fishing. They are capricious, however, in the matter of bait. Lobworms, gentles, paste, boiled wheat, caddis, and wasp grubs may all be offered in succession sometimes, and without effect, until something is found that hits their fancy ; then the fun begins. A long, light rod and a fine running line, a small hook and six feet of fine, but undrawn gut, with a porcupine or swan-quill float, painted green, are the chief necessities for the bream-fisher. The practised bottom-fisher generally knows by the movement of the float what kind of fish is at his bait. In the case of the bream this movement is peculiarly characteristic, for the fish first seizes the bait with a lifting motion, which takes the weight off the float and throws it flat on the water. After that the

float is drawn under by a leisurely, sidelong movement, and then is the time to strike.

The other method of angling for bream is with a ledger, as for barbel, but with finer tackle. This can be done with a much shorter rod than in float-fishing. It is the only proper means to fish the strong water below weirs, where bream are very fond of congregating. Whether in still water or streams it is advisable to ground-bait liberally, either with clay-balls containing worms or with handfuls of boiled wheat.

When hooked, a good bream plunges heavily and bores away to the deep water. Experts bear as hard on their fish as the tackle will stand, in order to bring him to the top of the water, knowing that the bream soon shuts up if he is kept stiffly on the surface. Pond or lake fishing for bream gives the greater return in numbers and size, but river bream, says Mr. Wheeley, are more desirable in one respect, at least, than those of still waters—they are not nearly so thickly covered with slime. Pond-bred bream exude mucus so freely that, after playing one of them in deep water, the line and tackle are often thickly coated with flakes and ropes of defilement; they cover any bag or basket with filth, and even the boat or punt; so it is customary to put them, when caught, into a keep-net, slung over the side of the boat. A bream from a swift weir-stream in Thames or Trent is quite a different fish—bright, firm, and not unpleasant to handle.

The average size of bream is considerable, from 2 lb. to 4 lb. being a common weight for it in Britain. Professor Seeley records having seen one taken from the Serpentine, in Hyde Park, weighing between 7 lb. and 8 lb.* Frank Buckland noted the measurements of a bream taken in August, 1869, from a small pond at Beeston Regis, near King's Lynn. It measured two feet two inches in length from tip of snout to fork of tail, and weighed $11\frac{3}{4}$ lb. The river Wensum is noted for large bream. On August 4th, 1902, Mr. H. Cullingford,

* *Fresh-water Fishes of Europe*, p. 212.

of Norwich, landed one from that river weighing 6 lb. 8 oz., and has one in a glass case in his house which pulled the scale to 7 lb. 5 oz. Another gentleman, whose name I have mislaid, killed two in September, 1901, in the Wensum weighing 6 lb. and 7 lb. 13 oz. respectively. He states that he knows "authoritatively" of bream from the Wensum weighing 9 lb. 4 oz., 9 lb., and several others over 7 lb.

The White Bream, or Breamflat (*Abramis blicca*)

FINS.

Dorsal: 11 rays.

Anal: 22 to 27 rays.

Ventral: 9 or 10 rays.

Pectoral: 14 rays.

TEETH.

Pharyngeal, in two rows, 1 or 2 and 5—5 and 2 or 1; notched at the ends and slightly hooked.

The white bream, or breamflat, is neither so large a fish as the common bream, nor so abundant in England, where it is only found in the Trent, the Cam, and a few other streams of the eastern watershed; but it has a wide range on the Continent north of the Alps, and is one of the commonest fishes of Central Europe.

The marked and constant difference in dentition between this fish and the common bream—the teeth of the latter being arranged in a single series, those of the white bream in two rows—has led some naturalists to place it in the separate genus of *Blicca*; but this seems an unnecessary and artificial separation of two species which are so closely similar in other respects. Besides the difference in the teeth, the breamflat may be distinguished from the bream—first, by its colour, which is always white and silvery with bluish reflections, without the brown and brassy tints of the other, the iris being silvery, flecked with green, the pectoral and ventral fins more or less red at the base; second, by the nearly symmetrical lobes of the tail fin; and third, by its average size, which is far less than that of the bream, a breamflat seldom attaining a foot in

length or a pound in weight. It is a worthless fish, for which nobody has ever been heard to say a good word. It is needless, therefore, to refer to the methods of angling for "tin-plates," as fishermen call them, except to say that they are the same as for bream. In habits, and food also, the two fish are precisely similar, the breamflats bringing themselves prominently under notice in May, when they gather in shallow water, especially among bulrushes, and deposit their spawn and milt in riotous assemblage.

The breams are represented in North America by several species, resembling the European breams, but generally having fewer rays in the anal fin. As already mentioned, the so-called Pomeranian bream (*Abramidopsis Leuckartii* of Von Siebold) has been pretty well ascertained to be a fertile hybrid between the roach and the bream. It has been described by Günther as "a roach-like modification of the bream, or a bream-like modification of the roach." It is to be noted that the sea-breams (*Sparidæ*) are not akin to the fresh-water breams, but form the fourth family of a totally different order—that of *Acanthopterygii*, or Spiny-finned Fishes.

The Bleak (*Alburnus lucidus*)

FINS.

Dorsal : 10 or 11 rays.

Anal : 18 to 23 rays.

Ventral : 9 or 10 rays.

Pectoral : 15 to 17 rays.

Caudal : 19 rays.

TEETH.

Pharyngeal only, in two rows,
hooked.

Sixteen hundred years ago Ausonius, describing waterside life on the Moselle, noticed the sport which schoolboys found in catching bleak. The relations between boys and bleak remain unchanged ; many a salmon-fisher, hardly to be satisfied now with less than a thirty-pounder in the full sweep of a Norwegian torrent, may trace his craftsmanship to its source

by recalling the nimble, silvery, tiny fish which it took so much delicacy and quickness of hand to secure.

The name "bleak" is of very appropriate significance, for it is founded on the most distinctive characteristic of the fish. When it was conferred upon it, automatically and involuntarily, like all good names, it meant "shining," for that was the sense of the Anglo-Saxon *blæc*. Afterwards it came to mean pale and wan, suggestive of desolation, but the root meaning is that of the Greek *φλέγειν*, to burn or shine. It is curious, therefore, to note that the words of such diverse suggestion as "bleak" and "flame" actually have arisen from a common source. Yet the two ideas appear not widely dissociated in this glittering little fish, for it is in blazing hot weather when you will most surely see him, hovering a few inches under the surface in any part of the Thames, darting after flies and taking samples of everything edible that floats down the stream. No longer are sewers allowed to discharge their noisome contents into the chief of English rivers, whereby bleak have been bereft of their happiest hunting-grounds; for although they love the fairest streams, they are undoubtedly foul and indiscriminate feeders, and subject to great quantities of internal parasites.

The colour scheme of the bleak is very delicate; steel-blue to greenish on the back, bright silver on sides and belly, which are covered with delicate scales; iris pale golden; dorsal and caudal fins grey, the others semi-transparent and without definite tint. It betrays its kinship to the bream by the long base of the anal fin, and the sharp keel of the posterior abdomen. In size it is always diminutive, seldom exceeding four or five inches in length.

The geographical range of the bleak seems to be co-extensive with that of the bream, save that it is not found in Ireland, nor, I think, in Wales. Besides the bleak, there are fifteen species of *Alburnus* in Europe and Western Asia, some of them very closely resembling the British one.

Few people of mature age would be at the pains to catch bleak, either for sport or because of their quality on the table. Some there are who affirm that bleak ^{The uses of} are no whit inferior to sprats, others pronounce them insipid and even disagreeable. For my own part, were I inclined for a meal upon small fish, I should choose one like the sprat, a cleaner feeder and less infested with parasites than the bleak. Nevertheless, it is sometimes of the utmost importance to one intending to angle for nobler fish—Thames trout, for instance—to be able to obtain a supply of bleak. True, one can always telegraph to any London tackle-shop for a jar of small fish, beautifully bottled and preserved in formaline, but sometimes one stands in immediate want of bait. At such crises it is well to know how to catch bleak. There is not much difficulty in that, provided the sun be hot and the air calm. Cold blustery weather puts them off the feed altogether, and they disappear from view; but so long as they are cruising about near the top, any small artificial fly will attract them. You must use the finest of tackle, drawn gut or, better still, single horse-hair; for bleak have brains, and learn very quickly to use them in a river so full of snares as the Thames.

Those who make it their business to catch bleak for bait, and to supply the tackle-makers with them, do not depend on the artificial fly. They keep gentles in a jar, covered with muslin over the top, till they turn from white maggots to brown chrysalis, and finally to bluebottles. No bleak that ever was born can resist a fat bluebottle; and if you are well supplied with these, killed by pouring boiling water over them, the services of a professional with a casting-net will seldom be required. But to avoid disappointment, you must ground-bait cunningly. Bread is the best for that purpose, but bread cast upon the waters is soon floated away, and the bleak follow it. Cast your bread, therefore, but let it be a slice secured to your punt

by a thread. Many bleak will gather round it, and you shall reap the reward of foresight by casting your gentle, your bluebottle, or your artificial fly among them.

There remains to be noticed the chief economic use which has been found for the bleak. The silvery lustre of its scales is chiefly the result of a substance called guanin, which exists, more or less, in the scales of most fish, but is more abundant and of better quality in those of the bleak than of any other British fresh-water fish. Guanin is named from its presence in guano, the fossil or accumulated excrement of sea-birds; but inasmuch as it is not found in their recent excrement, it is believed to be formed by the oxydising action of the atmosphere upon uric acid. Very long ago the secret was discovered of applying the glittering substance on the scales of the bleak to the manufacture of artificial pearls. The Chinese, it is said, were the inventors of the process; but the industry became firmly established in France more than two hundred years ago, when a great demand ensued, and was maintained till Yarrell's day (1784-1856), for Thames bleak and whitebait, which were manufactured into what was termed in the trade *essence d'Orient*.

The process is described as follows: The scales on the abdomen having been scraped, washed, and trituated in water, the iridescent pigment falls to the bottom of the vessel. It is said to be either phosphate of lime or phosphate of magnesia, containing guanin. The sediment is then placed in liquid ammonia and preserved for use, as *essence d'Orient*, the best being yielded by the whitebait* and valued as high as five guineas an ounce; the scales of the bleak being next highest in repute. Roach and dace yield a more plentiful, but inferior kind of pigment, not so lustrous and tinged with yellow.

* Formerly believed to be an adult fish, but now proved to be the young of the herring and the sprat.

False pearls are made by introducing this pearl mixture into very thin bulbs of glass, some of which are blown in irregular shapes, to increase the resemblance to real pearls. Liquid white wax or gum arabic in solution is afterwards injected into the beads to make them solid ; the glassy surface is then slightly dulled by exposure to the vapour of hydro-fluoric acid, and the illusion is so complete as to deceive all but expert scrutiny.

Fourteenth Sub-Family : COBITIDINA : THE LOACH GROUP

This group is formed of a number of genera of small fishes, none of them more than a few inches in length, distributed over the Old World and not represented in the New. Externally they suggest connection with almost anything rather than the last group described—the breams—resembling miniature barbels or gudgeon more than any other of the carps. The body is greatly elongated, the mouth is always surrounded by barbules, never less than six in number, and the air-bladder is partly or wholly enclosed in a bony capsule. Of the three European genera, two only are represented in Britain, each by a single species.

The Loach (*Nemachilus barbatulus*)

FINS.	TEETH.
<i>Dorsal</i> : 9 or 10 rays.	Pharyngeal, in a single series.
<i>Anal</i> : 6 or 7 rays.	
<i>Ventral</i> : 7 rays.	
<i>Pectoral</i> : 12 rays.	

The genus *Nemachilus*—thread-tipped—consists of about fifty species, distributed in a wide range from the Malay Archipelago through Asia and Europe as far west as Ireland, but not represented in Denmark or Scandinavia. Of all these numerous species, only one, *Nemachilus barbatulus*, is

known to inhabit European waters. Of the name "loach" no explanation has been received.

Wherever in Britain there runs a limpid brook over sandy and gravelly shallows, one may expect to find loaches, lurking under stones, much sought after by greater fish, by birds, and even by man, because of the sweetness of their flesh. But you must have quick eyes to detect them, so closely does their mottled skin accord with the ground of their haunts, and nimble fingers to catch them, so slippery are their sides with abundant mucus.

In appearance the loach is distinguished by its elongated body, nearly cylindrical, measuring in length seven or eight times its height. The head is relatively long and broad; the eyes are small and set high in the head; but it is probable that the fish depends less upon these organs in pursuit of its prey than upon six sensitive barbules, delicate instruments of touch, which hang from the upper lip. Above and below the eye is a conspicuous row of mucus channels. The back is olive-green, the sides yellow, and the belly greyish-white, and this ground colour is boldly marbled with very dark brown, which extends over the dorsal and tail fins. The other fins are tinged with yellow. The caudal fin is rather fan-shaped, rounded at the angles and not forked. The skin, except on the head, breast, and abdomen, is covered with exceedingly minute scales, which, however, resemble those of the tench in being separate one from the other—not overlapping.

The loach spawns earlier in the year than other British cyprinoids, breeding in March or early in April. It is a ground feeder, living, it is believed, exclusively on animal diet. People who speak from experience are enthusiastic about the delicacy of its flesh; but, under ordinary conditions, the labour of collecting a dish of loaches must be out of proportion to its value, for the fish seldom reaches five inches in length, and is more commonly much smaller even than that.

Linnæus states that Frederick I. introduced the loach into Sweden, because of its excellence on the table.

The distribution of the British loach suggests some interesting reflections, pointing to the high antiquity of the species. The Carp Family are of such a plastic and variable constitution that one would expect to find considerable local variation from the original type of this species. Yet the loach is the same all over its vast range, although its presence in westward-running streams in Scotland and Ireland proves that the separation between individuals must have been complete for almost incalculable ages. It is so little tenacious of life as to die within a very few moments of removal from the water ; wherefore its occurrence in streams now far remote and disconnected from each other can hardly be explained by the accidental transport of young fish or spawn by means of birds. Altogether this tiny fish offers one of the most interesting, and at the same time perplexing, studies in British ichthyology.

This species and the next are the only British fresh-water fish that have the air-bladder enclosed in a bony capsule.

The Spined Loach (*Cobitis tania*)

FINS.

Dorsal : 10 rays.

Anal : 7 rays.

Ventral : 6 or 7 rays.

Pectoral : 6 to 9 rays.

Caudal : 13 rays.

TEETH.

Pharyngeal, in a single series.

The genus *Cobitis* is distinguished from *Nemachilus*, which it nearly resembles, by the presence of a small spine, bifid and erectile at will, below each eye. The object of this armature is obviously defensive, but it must be far from effective. The genus consists of but few species, chiefly inhabiting the waters of India, Japan, and Europe. Only one species has found a home in England, where it seems to be confined to some of the

southern and midland counties, and must be accounted rare in Britain. It has not been reported either from Scotland or Ireland, but it may well be that such a small fish, of exceedingly retired habits, has escaped observation in some parts of our islands, or been confused with the commoner stone loach. As in the case of *Nemachilus barbatulus*, so in that of *Cobitis taenia*, the wideness of range is one of the mysteries of Nature. It has been identified in Japan, though not in continental Asia, and it extends from the Caucasus, through Central Europe, to the rivers of Wiltshire.

The body of the spined loach is elongated in the same proportions as that of the stone loach ; but it is not nearly so cylindrical, being laterally compressed so that the thickness from side to side is half the depth from back to belly. It has six barbules on the upper lip ; the eyes are small, set high in the head, with pale yellow irides ; and the skin of the head extends over them, as it does not do in the stone loach. The characteristic bifid spines under the eyes lie flat when at rest, and are erected in the presence of danger. They are very small, the hinder and longer limb of each being no longer than the diameter of the eye itself. The scales are very minute. The colouring of the body is somewhat fantastic, consisting of black blotches arranged more or less regularly in two lines on each side of the body upon an orange ground. Between these two lines occur irregular black flecks and dots. These markings do not extend over the abdomen. A peculiar black streak runs from the eye to the front of the upper lip. In length this fish never exceeds four inches, and its mode of life is similar to that of the stone loach, though it is said to have more of the burrowing habit than its congener.

Plate by E.T. Magoon



Twice Natural Size

THE LOACH (*Nemachilus barbatus*)



$\frac{3}{4}$ Natural Size

THE PIKE (*Esox lucius*)

CHAPTER XI

THE PIKE

The Pike—Habits—Distribution—Pike as Food—Angling for Pike.

Tenth Family: ESOCIDÆ: THE PIKES

THE Pike Family is limited to fresh water, and contains but a single genus—*Esox*—whereof one species, *Esox lucius*, is common to Europe, Asia, and America. The last-named continent produces, in addition, about five other species, very similar in general appearance and habits to the British pike. It is an ancient type of fish, members of the existing genus having been found in a fossil state “in the fresh-water chalk of Oeningen and the diluvial marl of Silesia.” *

The Pike (*Esox lucius*)

FINS.

Dorsal: 19 rays.

Pectoral: 15 rays.

Ventral: 10 rays.

Anal: 19 rays.

TEETH.

Numerous: those on the mandible recurved, in a single series, five or six on each side, unequal in size. Bands of sickle-shaped teeth on the vomer, palate, intermaxillary, and hyoid bones. None on the maxillary.

It has often been asserted that the pike, now universally distributed over Great Britain and Ireland, is not truly indigenous, but was introduced in the same manner as carp;

* Günther, *Introduction to the Study of Fishes*, p. 624.

but this is conclusively disproved by abundant fossil and semi-fossil remains in the peat of the Fens. No doubt pike have been established by the agency of man in waters where they did not naturally exist, for the rapidity of their growth, as well as the large size to which they quickly attain, rendered them valuable to ecclesiastics and others when periodical fasting from flesh was the rule. In the present day, when they no longer furnish an important article of diet, the presence of pike must be considered an unmitigated evil, so vast is the havoc wrought by them among more valuable fish.

Of old this fish was commonly known in English as the luce, which name came to us through the old French *lus*, from the Latin *lucius*, and further it cannot be traced ; but this has been superseded by the term pike (a doublet of "spike"), which refers to the general stiff sharp form of the creature. In Scotland and Northern England it is universally known as the gedd, a Scandinavian word signifying a "gad" or "goad," and therefore intended to convey precisely the same similitude as that of "pike."

In appearance the pike resembles no other British fish. The head is peculiarly long, broad, and flattened ; the body is much elongated, the total length of the animal being about six times its greatest depth ; and the dorsal fin occupies a position right opposite the anal fin, and therefore far behind the centre of the body. The back, the sides, and the belly are all flattened, so as to give the body a quadrangular section. The dorsal, caudal, and anal fins, set together on the muscular tail, form a propelling apparatus of great power, enabling the fish to dart swiftly upon his prey, which his capacious and formidably-armed jaws are well designed to seize and hold.

The eyes are large, set high in the middle of the head, separated from each other by a space only equal to the diameter of one of them. The irides are yellow. The mouth opening extends nearly half the length of the head, the lower jaw projecting beyond the snout. The tooth armature is extensive

and effective. The maxillary bones, forming the side margin of the upper jaws, are toothless ; the intermaxillary bone, forming their front margin, is covered with rows of small recurved teeth, as also are the vomer, the palatine bones, and the hyoid arch which forms the roof of the mouth and covers the branchial apparatus, or gills. The mandible, or lower jaw, carries five or six large recurved teeth on each side, with smaller teeth interspersed. These teeth are firmly fixed, but those on the roof of the mouth, which are set in three dense bands, are hinged posteriorly, so as to bend back and admit the easy passage of such animals as the pike may seize. All things considered, a more perfect predatory instrument could scarcely be devised than the mouth of a pike, especially for the capture of nimble and slippery objects.

The body is covered with small cycloid scales,* the colour varying considerably with the seasons. The back is intensely dark olive at all times ; except in the spawning season the sides are grey and green, with a slight silvery lustre, handsomely marbled with primrose-yellow. Under a magnifying glass it may be seen that the scales of the lateral region are closely powdered with dots of dark pigment, except on the yellow markings. The dorsal and anal fins are light olive, marbled with black ; the pectorals and ventrals have a russet or orange tinge ; the tail fin is light olive, horizontally striped with black. In spring, when the sexes pair, the body tints deepen, the green on the sides becomes beautifully vivid, and the pale yellow markings turn to gold, which spreads somewhat lower on the body than at other times.

The pike is a solitary fish, except during the brief season when he associates with a mate for reproductive purposes.

Indeed, he adopts very effective measures to secure the solitude he desires by swallowing all the smaller individuals of his kind into which he can set his teeth. Some

Habits.

* Cycloid scales are those without a coating of enamel and with a smooth posterior margin.

years ago a London clergyman paid me a visit in Scotland. He had recently become acquainted with the charms of angling, and on the first morning after his arrival fixed a longing eye upon a large natural lake which lies in front of my house. To his enquiry about the sporting capabilities of this sheet of water, I could but tell him that it contained no fish except pike, perch, and eels, which are not highly esteemed in the North; in fact, they are cursed as vermin occupying thousands of acres which ought to be peopled by the nobler trout. However, it was September, and both pike and perch were at their best. Tremulous with excitement my friend disappeared directly after breakfast, and I saw no more of him till I came in that evening in time for dinner. Never did I behold a man more unaffectedly delighted. There he was, dancing about among nineteen pike laid out before him, in lines, from 15 lb. downward. It was my destiny to damp his pride in the biggest fish. Observing a suspicious fulness in its abdomen, I caused it to be cut open, which revealed the secret of the convexity. A jack* of 2 lb. weight, recently swallowed, was in the stomach of the brute, whereby the weight of the fifteen-pounder was virtually cut down to 13 lb.

Nor is this incident exceptional. Pike are habitually cannibals; quantity, not quality, is what they demand, and the only line they draw in diet is at what cannot be swallowed. Apologists for the pike, if such there be, might draw tears by describing the anguish of a large pike on having by accident seized what he fancied, in the dim light of some deep mere, was a lusty trout, and found, too late, that it was a great-grand-nephew, or even one of his own children. Too late! yes, because nothing upon which those fearful jaws once close can ever retreat from them. The multitude of sickle-shaped teeth can only be withdrawn by bending them backwards, thereby forcing the victim still further into the trap.

* Pike under 4 lb. weight are usually called "jack."

"My dear boy," the old sinner may be represented as mumbling, with his mouth full, "if I had only known, nothing would have induced me to touch you! My eyes are not so good as they were; I had not the slightest idea it was you. It is enough to break your old dad's heart; but you see I *can't* let you go; so lie still, I pray, and it will soon be over."

That sounds all very well, at least it might do so were there anything extraordinary in such a circumstance. But jack are found too constantly in the interior of their relatives to justify the hypothesis of accident. I myself have seen two—one fresh, the other half digested—in the stomach of one moderately-sized pike. Unsparing of his own kind, the pike is relentless in his persecution of other living creatures. It is pitiful to see a mother wild duck going afloat on a spring morning with a string of a dozen or so of plump little ducklings, and to watch the bevy dwindle day by day, until at last but one, or at most a pair, remains. So with salmon smolts. These little fellows put on their silvery sea-jackets in spring and begin dropping down the rivers in shoals. If there are pike in the stream, as is too often the case in salmon rivers, the proportion of valuable fish destroyed is simply incalculable. In May last year (1901) I was fishing a favourite salmon-cast, the only bit of swiftish water in a sluggish stretch of two or three miles, wherein pike do greatly abound. Just as my fly came to the very spot for a spring fish, the line tightened bravely. "In him!" I ejaculated mentally; but next moment a wretched little jack of some three pounds was floundering on the surface. I dragged it ashore, put further mischief out of its power with a rap on the head, and had the curiosity to open it to ascertain what it contained. The ovaries were full of ripe spawn, almost ready to be shed, and in the stomach were two beautiful silvery smolts—potential twenty-pounders—swallowed within fifteen minutes of the death of their captor. Now, methought, within these three miles of water there must be, at the very lowest

computation, five hundred hungry pike. Suppose they each take but five smolts a day for a week on end, that means the slaughter of exactly 17,500 young fish which, with luck, would have returned to the river as full-grown grilse and salmon. And note that, in the river in question, there are many still reaches besides this particular one, fringed with reeds and swarming with pike, through which every descending smolt has to run the gauntlet. There is only one fish known to me which defies the pike—the stickleback, to wit, which, though the pike may fill his mouth withal, he has to eject because of the prickles, and *can* eject, for the horny armour of the little creature prevents the recurved palatal teeth fixing it inextricably. The perch manages to hold its own with the pike, even in enclosed waters, partly in virtue of its defensive spines, and partly because of its great reproductive powers; nevertheless, small perch very commonly fall a prey to the omnivorous tyrant.

The tactics of the pike in pursuit of prey are stealth and ambush, culminating in a fierce rush. His mottled coat is gay enough when you have him on the bank; but in the water it agrees so well with the weeds and shadows that the fish is very difficult to detect. Then he has a strange power of holding himself, not head to stream, as most fish lie, but at almost any angle to the current—stiff, motionless, indistinct, more like a stock than a living creature.

Countless stories have been printed about the insatiable voracity of the pike, and these it boots not to repeat here; but I may describe one incident which came under my own notice. A friend was trolling in the Scottish lake above referred to and hooked a large pike, which offered a poor resistance. When we landed it, we found that it was emaciated to the last degree, a fish which, in proportion to its length, ought to have weighed more than 20 lb. In effect it only brought the index down to 9 lb. The cause was soon apparent. Far down in its gullet was a large double night-line, or trimmer

hook, with the barbs deeply embedded on either side, so as completely to bar the passage of food. The wretched creature must have died eventually of starvation, yet it came gallantly at the spinning-bait.

In further illustration of the pike's voracity, one other deserves to be cited, though of a very familiar type, because it has been so well authenticated. In April, 1870, two boatmen on Loch Tay, noticing a disturbance in the water, rowed to the spot and saw two fish, which they supposed were fighting. With a single stroke of the gaff, both fish were drawn into the boat, when it was found that they were a brace of pike, weighing together 19 lb. and nearly equal in size. The head of one was firmly fixed as far as the pectoral fins within the jaws and gullet of the other. A cast of this singular pair is, or used to be, in the Buckland Museum at South Kensington.

Pike are equally at home in lakes and in rivers; and albeit they prefer the steadier and slower parts of streams, yet they can maintain their station in pretty strong water. They spawn in spring, the season in Britain varying from the middle of March to the middle of May, according to temperature and elevation. The ova are reddish-yellow, rather large, but smaller than, and not unlike, those of the *Salmonidæ*. Buckland counted the eggs within a female pike taken with rod and line from the Norfolk Broads in April, 1870. This fish measured 3 ft. 8 in. in length, and weighed 32 lb.; the ovary weighed 5 lb. and contained 595,200 eggs. In a pike measuring 3 ft. 7 in. and weighing 28 lb., taken in Loch Awe during the previous October, the roe weighed only 21 oz., and contained 292,320 eggs. Thus the roe of the larger fish weighed nearly four times as much as that of the smaller fish, though it contained only twice as many eggs; which, of course, is explained by the greater development of the eggs on the eve of spawning. Unlike the salmon, which usually undergoes long periods of abstinence before spawning, and nourishes its roe at the expense of its muscular tissues, pike continue to eat

as voraciously before and during the season of reproduction as at any other time ; consequently, the Loch Awe fish above-mentioned, measuring only an inch less in length than the Norfolk fish, but weighing 4 lb. less, would probably have come within 2 lb. of the other by the following spawning season.

It is certain that there is no definite standard of size for this fish, as there is in the case of such teleosteous fish as herrings and sticklebacks. A pike will continue to grow so long as sufficient food is supplied to sustain him, and there are many stories of pike weighing as much as 70 lb. or 80 lb. ; but few, if any, of these tales will stand testing by the rules of evidence. For my own part, I yield implicit credence to Colonel Thornton's narrative of the capture of two monsters in the Highlands. Reference has been made above to the great perch which he caught in Loch Lomond ;* having expressed my belief in that, I see no reason to withhold it from the measurements given of the great pike of Loch Alvie. This fish was 5 ft. 4 in. from the eye to the fork of the tail. The Colonel's scales only went to 29 lb., and he was obliged to calculate the weight of his prize, which he did at 47lb. or 48lb. Assuming the length given to be correct, this estimate tallies with the authentic record of the proportions of a pike taken from Lough Romer, co. Cavan, in 1876, which measured 4 ft. 6½ in. long, 25 in. in girth, and weighed 37¾ lb.†

Garrard, a well-known painter of sporting subjects, and afterwards an Associate of the Royal Academy, was with the Colonel upon this tour, and painted the portrait of this pike. It now hangs in the saloon of the Piscatorial Society in the Holborn Restaurant.

When Whittlesea Mere was drained early in the nineteenth century, it is recorded that a pike weighing 49 lb. was left high and dry by the falling waters. No such monster was revealed

* See p. 51.

† *Field* newspaper, May 30th, 1896.

in 1862, when my father spent £3,000 in draining Dowalton Loch, the largest sheet of water in Wigtownshire. Legends of huge pike inhabiting its depths had ever been current in the neighbourhood, but, strange to say, among thousands of pike and perch captured when the waters ran off, there was no fish taken of a greater weight than 12 lb. It was supposed that the larger fish had been smothered and lost in some hundreds of acres of mud laid bare.

Pike lend themselves readily to the fisherman's proverbial appetite for the marvellous. I once asked an old gillie of mine, usually very laconic, whether there were pike in a certain loch.

"Pike!" he exclaimed, with a ring of sarcasm in his voice. I had touched the spring of his loquacity, for he proceeded—"Ae day I was gangin' along the side o' yon loch, an' I see'd a thing in the watter, I thocht it was a tree. An' then I saw twa e'en in it."

"And what was it, Sandy?" said I.

"Oh, it was a pike," quoth he.

"And what did you do, Sandy?"

"I gaed back from the loch for fear of him!"

Then, with the craft of a true artist, he fell silent. Words could do no more. I could not induce him to hazard an estimate of the weight of this great fish; but it must have been vast, for never, before or since that time, did I ever hear Sandy say so much about anything.

In 1897 the late Lord Inverurie addressed an enquiry through the *Fishing Gazette* into the authentic records of large pike taken within recent times in the British Islands. Mr. Alfred Jardine, a well-known authority upon pike-fishing, furnished the following list, of which he considered the details "beyond dispute." It will be noticed that, although more large pike are reported from Ireland than from Great Britain, only five Irish captures are included in Mr. Jardine's catalogue, owing to the difficulty of verifying the details. None are

noted from Scottish waters, chiefly because few people ever think of angling for pike where fish of better quality so greatly abound.

Year.	Date.	Weight.	Place.	Mode of Capture.	Captor.
1869	October	28 lb.	Loch Awe	Rod and line	Mr. G. Rooper.
1870	April 2	32 lb.	Norfolk	" Net "	Not recorded.
1874	October	35 lb.	Rapley Lake, Bagshot Park	" "	—
1875	January	26½ lb.	Hampton Deepes, Thames	Snap-tackle	Mr. Luton.
1876	Jan. 2	21 lb.	River Frome, Dorset	" "	Mr. A. Jardine
"	July	20 lb.	Marlow, Thames	Gut perch paternoster	Mr. Wm. Ritchie.
1877	Jan. 5	21½ lb.	Sonning, Thames	Snap-tackle	Mr. A. Jardine.
"	Feb. 24	36 lb.	Maidstone, Kent	" "	" "
1878	Jan. 3	20½ lb.	Sonning, Thames	" "	" "
"	Jan. 30	27½ lb.	Hampton Deepes, Thames	Paternoster	Mr. Barker.
"	February	29 lb.	Near Norwich	Snap-tackle	Mr. English.
"	Feb. 4	22 lb.	River Frome	Paternoster	Mr. A. Jardine.
"	Feb. 17	"	Bardney, river Witham	Gorge	Not recorded.
"	Feb. 23	30 lb.	Lough Erne	Pike-fly	" "
"	Feb. 24	36 lb.	Near Norwich	Snap-tackle	Mr. T. Thorne.
"	Feb. 27	23 lb.	Near Petworth	" "	Mr. A. Jardine.
"	March 14	22½ lb.	Near Chippenham	Paternoster	" "
1879	Feb. 14	21½ lb.	Near Petworth	Snap-tackle	" "
"	Feb. 24	24 lb.	Eastwell Park, Kent	Not recorded	H.R.H. the Duke of Edinburgh.
"	Feb. 28	24½ lb.	Near Chippenham	" "	Mr. Pallison.
"	Sept. 4	37 lb.	Near Amersham	Snap-tackle	Mr. A. Jardine.
1880	March 8	22 lb.	Near Petworth	" "	" "
"	April 10	27 lb.	Near Halberton	Not recorded	Mr. Frost.
1882	Jan. 3	23 lb.	River Frome	Snap-tackle	Mr. A. Jardine.
"	Feb. 23	30½ lb.	Near Glynde, Sussex	Paternoster	" "
1883	July 2	24 lb.	Marlow, Thames	Gut barbel tackle	Mr. J. Bedford.
"	Nov. 27	24¼ lb.	Near Norwich	Not recorded	Mr. English.
1884	Jan. 19	23 lb.	Near Chippenham	Paternoster	Mr. A. Jardine.
"	"	21 lb.	" "	Snap-tackle	" "
"	"	20½ lb.	" "	" "	" "
"	"	19½ lb.	" "	" "	" "
"	"	19 lb.	" "	" "	" "
"	Nov. 20	21½ lb.	Sowley Pond, Lymington	Spoon-bait	Mr. C. Butler.
"	"	28 lb.	Sowley Pond, Lymington	" "	Mr. H. Ritchie.
1887	Feb. 15	26 lb.	Near Chippenham	Snap-tackle	Mr. R. B. Marston.
"	"	23 lb.	" "	" "	Mr. S. W. Searle.
1888	Nov. 14	22 lb.	Hayward Wide- water, Stafford	Spinning gudgeon	Mr. H. Evans.
"	Nov. 25	"	Maidstone	Snap-tackle	Mr. A. Jardine.
"	"	19½ lb.	"	Paternoster	" "

Year.	Date.	Weight.	Place.	Mode of Capture.	Captor.
1890	Feb. 1	20½ lb.	Hayward Wide-water	Snap-tackle	Mr. B. Preece.
1891	Dec. 17	19½ lb.	Hayward Wide-water	„	Mr. W. Osborne.
1892	May 27	26½ lb.	Lough Arrow	Spinning trout	Mr. Rothwell.
„	Dec. 1	22½ lb.	Hayward Wide-water	Snap-tackle	Mr. W. Osborne.
„	Not recorded	33 lb.	Lough Mask	Not recorded	Mr. W. F. Laurie.
1893	„	37 lb.	Shannon	„ „	Not recorded.
„	Nov. 13	21½ lb.	Hayward Wide-water	Snap-tackle	Mr. I. Evans.
1894	Jan. 16	25 lb.	Near Maidstone	Live dace snap-tackle	Mr. J. Sheather.
„	April	32 lb.	Lough Conn, co. Mayo	Blue Devon minnow	Mr. E. H. C. Smith.
1895	December	21 lb.	Barratt's Pool, Leicestershire	Live bait	Not recorded.
„	„	25 lb.	River Dove, Staffordshire	Snap-tackle	Mr. J. C. Wright.
1896	Feb. 19	20 lb.	Near Chippenham	Gut perch	Mr. A. Jardine.
„	Nov. 22	30 lb.	Dagenham Lake, Essex	paternoster Not recorded	Mr. Waller.

The British pike is found in the northern temperate parts of all the three great continents, and is the only species belonging to the Old World; but in North America *Distribution.* it inhabits the same waters with five other nearly allied species, whereof the maskinongé (*Esox estor*) is the largest. Mr. Walter Nursey assures me that the maskinongé bears the same relation in culinary value to the common pike as the canvas-back does to the domestic duck, which implies a high degree of superiority. The name *maskinongé* is usually written “maskalonge,” or “muskelunge,” which betrays ignorance of its meaning. I am indebted to Mr. Nursey for an interpretation of the term. *Kenonjai* (the *j* is sounded as in French) is the Ojibbeway Indian name for the pike; the prefix *mas* or *mis* signifies “great,” as in Mississippi, “the great river.” Maskinongé, therefore, simply means the great pike; which, unlike so many popular names, is a perfectly correct description of the creature.

In Britain the distribution of the pike is sometimes very

puzzling. It is not easy to account for its presence in certain waters, and its absence from neighbouring and similar ones. For example, in my native parish of Mochrum, Wigtownshire, there are ten natural lakes, from two hundred acres down to one acre in extent. Some of these are basins scooped out of the glacial till, others are depressions in the prevailing Lower Silurian rock beds. Pike swarm in eight of these lochs, and are wholly absent from two of them. Long may they remain so, for their room is occupied by numbers of very good trout. Still more remarkable is the capricious distribution of pike in the southern uplands of Scotland. They infest most of the waters, both running and still, but here and there occur lakes, such as Loch Grennoch, abounding in trout and char, and the two Glenhead lochs in Glentrool, where no pike are found. The fry, of course, find their way wherever a rill runs or a drain trickles, but some of these hill lochs are situated so high that the pike therein must be descended from an ancestry established when the land levels were different. In such an elevated and desolate region, the presence of these fish can scarcely be attributed to the agency of man.

Pike, nearly allied as they are to the *Salmonidæ*, ought to be excellent food, and some there be that profess to find them so. As for me, I have tried hard to relish them in
 Pike as food. various forms, but have never been able to overcome a strong repugnance to the flesh. Nor is this prejudice, as it might easily be in a mere matter of taste, over which reason exercises no control. This was proved one day in a very practical way at my own table, where pike are *tabu*. I helped myself to what appeared to be excellent fried fillet of cod; the first mouthful was unaccountably nasty; I looked more closely at the fish and detected a thin forked bone, unmistakable sign of pike. And pike it was; my son having been disporting himself on the lake that day, had persuaded the cook to serve some of his spoil. Therefore, despite the authority of many eulogists, my opinion of pike is this:

that the dressing and stuffing should be as savoury and nutritive as possible, so that something edible may remain when you have thrown the fish away.

Adepts at pike-angling are enthusiastic about the game qualities of their quarry. The great size to which pike attain, ^{Angling for Pike.} their boldness in seizing the bait, and the powerful fight they make when hooked, certainly add zest to the sport which is denied to the angler for other coarse fish. There is, however, one feature in the craft which must always operate against its claim to be reckoned in the first rank, namely, the strength of the tackle which must be used. A fifty-pound salmon may be killed upon a strand of single gut; for the utmost pressure which can be brought to bear by the fisherman upon the fish, provided his rod is kept "in play," amounts to less than 4 lb., and good salmon gut will bear a strain of 8 lb. or 9 lb. But the teeth of a pike, even though he be of no more than mediocre dimensions, will soon saw through the strongest gut, and it is necessary to use metal gimp next the hook. A trace of sound gimp is generally strong enough to lift the dead weight of any fish that may be hooked, so that, even if the rod is pulled out of play, the tackle will stand a direct pull upon the reel line, which would be fatal in salmon-fishing.

It may be noticed in the list of large pike at page 172 that most of these fish were taken with what is known to anglers as "snap-tackle." In this method a hook is fixed in the dorsal fin of a live fish, such as a small dace or trout, and the other hooks are arranged over the head of the bait. A float is used, and adjusted so as to keep the bait about mid-water. It is not unnatural that many persons feel a dislike to tormenting a live fish by offering it as a lure to its deadliest enemy, and for these Mr. R. B. Marston has invented a snap-tackle for use with a dead fish. With this a float is not used; the bait is offered to the pike with a sink-and-draw motion, and it is said to be a method quite as successful as the other.

High-class pike-anglers regard the old-fashioned style of gorge-fishing, with live or dead bait, as unsportsmanlike, and rightly so, for it is an unlovely proceeding. In this method, if a dead bait be used, it is trolled in likely places ; and, as soon as a pike strikes it, he is allowed eight or ten minutes to swallow it. If the bait is presented alive, a float is necessary, but the process of fixing the bait to the hooks is so barbarous that I cannot bring myself to describe it here. In either case, the pike, having gorged the bait, is hooked in the stomach or far down the throat, and cannot make a fair fight. His only chance of escape is that the tackle should break, when the fish gets off only to die in a manner which it is sickening to think about. Even if the object be to destroy pike as vermin, it is far more humane, as well as more effective, to do so by trammel or draught nets. In clear trout-streams, also, pike may be snared by a noose of fine wire fixed at the end of a long, light bamboo. It is easy to detect the fish, lying motionless near the surface, and it is truly remarkable what skill is attained by adepts in noosing out jack even of very diminutive dimensions. Another amusing and artistic manner of disposing of pike in waters where it is desired to kill them down is with a rook rifle or air gun. In this art the aim must be directed seven or eight inches *below* the apparent position of the fish in the water, in order to allow for refraction ; and, whereas the pike is generally no more than stunned by the passage of the bullet, it is expedient to ladle him out with a landing-net as he floats belly upwards upon the surface.

Paternostering for pike is one of the most deadly means of taking large fish. The plan is similar to that employed for perch (see page 65), save that only one bait is used, and that must be a live dace, roach, or gudgeon.

The most lively and merciful method of angling for pike, as well as the most artistic, is certainly with the spinning bait, and few sportsmen would care to adopt any other, were it not for the undoubted fact that large pike

are less likely to be taken in this manner than with the live bait, or, at least, the dead bait on snap-tackle; big fish being not so nimble as smaller ones, and less inclined for the exertion of pursuing a rapidly passing lure.

Spinning is always done with a dead bait, fixed upon flights of triangle hooks so as to revolve rapidly in the water. It is difficult to explain why it is found profitable to give the fish used as bait a movement such as it could not possibly perform if alive, but undoubtedly it has an attraction for fish of prey. There is no better or simpler tackle than the Archer spinner, whereof there are many modifications under different names; and jars of beautiful baits—dace, gudgeon, sprats, and minnows preserved in formaline—may be had from any good fishing-tackle maker. Artificial baits of every conceivable design have been designed also—spoons, phantoms, fish of horn, of metal, of glass, of leather, of quill—all of which prove successful at times; but most anglers of experience prefer the natural bait.

Pike are often caught on the artificial fly when salmon-fishing, but generally of small size. The chances of landing a twenty-pounder on single gut are against the angler; for even if such a large fish be securely hooked, his serried rows of teeth, especially those on the vomer, are pretty sure to wear through the gut before he can be landed. Flies specially tied for pike are huge agglomerations of feathers, fur, and tinsel, but there can be no doubt that success is more probable with the spinning bait than with surface lures.

CHAPTER XII

THE SALMON

The Salmon—The Alevin Stage—The Parr Stage—The Smolt Stage—The Grilse Stage—Habits of Salmon—Salmon Leaps—Do Salmon Feed in Fresh Water?—Seasonal Change in Appearance—Process of Spawning—Kelts—Rate of Growth of Migratory Salmonoids—Artificial Incubation—Restoration of Salmon to the Thames—Salmon Disease—Early and Late Salmon Rivers.

Fifteenth Family: **SALMONIDÆ: THE SALMON FAMILY**

By far the most important of our fresh-water fishes, both from an economical and from a sporting point of view, are the *Salmonidæ*. Without troubling the reader with an anatomical analysis of the family, it may be mentioned that its members are easily distinguished from all other fish in British waters by the possession of two dorsal fins, whereof the second is always rudimentary and without rays—thick and fatty, hence called the adipose, or dead fin. This is the badge of the family, merely an envelope of skin containing nothing but gristly and fatty matter. Species of *Salmonidæ* inhabit both the sea and fresh water, as well as other species which perform a regular migration from one to the other; but, with a single exception, the fresh-water and migratory species are confined exclusively to the temperate and arctic zones of the Northern Hemisphere. The exception is a remarkable one—a small smelt (*Retropinna Richardsonii*) inhabiting certain lakes in New Zealand.

GENUS SALMO

It is discouraging to have to confess that there is no genus of fish about which there is so much conflict of opinion among ichthyologists as there is about that of *Salmo*. Yet, as befits the most important of our fresh-water fishes, it has received more attention than any other, both from men of science and from the Legislature. The sturgeon excepted, the largest, and without exception the choicest and most valuable, denizens of our lakes and rivers are of the salmon kind; they are at no pains to elude observation; the migratory species, passing up our moderately-sized rivers, penetrate some of the most populous districts, and perform the functions of reproduction in water often so shallow as not to cover their backs. The non-migratory species lend themselves readily to semi-domestication and to artificial reproduction; yet with all these opportunities of observation men have been unable to arrive at agreement upon some of the most obvious points for enquiry.

The classification of the whole genus is peculiarly perplexing owing to the striking changes in appearance affecting the various species at successive stages of growth and at different seasons of the year; and also, probably, to the production of fertile hybrids between the different species. Dr. Günther has arranged the genus *Salmo* into two groups—*Salmones*, or true salmon, distinguished by teeth extending over the whole length of the vomer, and *Salvelini*, or char, which carry teeth only on the front of the vomer—and thereby he has provided a convenient and intelligible aid to the study of the genus. And I desire not to be misunderstood if, in the present review of British fresh-water fishes, I am unable to follow Dr. Günther in his further definition of the various species. Nobody will suspect me, either of disrespect to the conclusions to which he has been brought by faithful and laborious research, or of a desire to put my

own opinions in competition with his. I have bestowed a great deal of attention upon the habits of *Salmonidæ*; but I am neither anatomist nor physiologist. Upon the question, therefore, of what degree and constancy of variation in structure should be recognised as constituting a distinct species, my opinion would be worthless. But, having observed how completely the offspring of some of Dr. Günther's species, such as the Loch Leven trout (*Salmo levenensis*), lose their hereditary characteristics in adapting themselves to novel environment; how quickly the ordinary brook trout (*Salmo fario*) acquires the appearance of the Loch Leven race when submitted to similar conditions of food and habitat; lastly, how imperceptible are the gradations between the different so-called species—I incline to the opinion of Fatio, Day, and other ichthyologists, which accounts for the so-called specific differences between the various kinds of sea, lake, and river trout as the transient effects of food, climate, and local environment.

In effect, I have taken a cowardly middle course, which will meet with the approval of neither party, by adopting Dr. Günther's subdivision of the genus *Salmo* into two groups—*Salmones* and *Salvelini*, salmon and char—and designating as species the leading types of each. I feel reassured in doing so by the fact that Dr. Günther's classification is admittedly tentative, was formulated nearly forty years ago, and that some of his minor specific differences can scarcely be said to have stood the test of subsequent observation.

In one respect all the genus *Salmo*, as well as some species of other genera of *Salmonidæ*, possess in common a remarkable and highly suggestive characteristic. Greatly as the adults of one species may differ in appearance from those of another, yet hardly more so than individuals of the same species differ among themselves, they all pass through a stage when not only all members of the same species are alike, but it is scarcely possible to distinguish one species from another. Yearly salmon and

migratory trout are coloured, spotted, and barred exactly like the young of lake and river trout, and in shape they are so closely similar as to require a long apprenticeship to enable one to tell them apart. Even experts cannot always agree about the species of these finger-marked salmonoids; in fact, the evidence about "orange-fins" of the Tweed, known as "yellow-fins" in the Solway rivers, is so conflicting that magistrates have refused repeatedly to punish persons convicted of killing them. Some witnesses declare them to be the young of migratory trout; others pronounce them with equal confidence to be the young of river-trout; while those of a third school are ready to swear that they are a distinct adult species.

The juvenile dark bars, finger-marks, or "parr-markings" disappear in the migratory series upon their first descent to the sea, and are seen no more. So also do they disappear in such brook or lake trout as abundance of food enables to develop to a large size. But where food is scarce or water scanty, or where trout multiply unchecked beyond the natural resources of a lake, the fish never attain what may be reckoned the average size of their species; they are stunted in growth, and *retain the finger-marks throughout life*. This tends to the conclusion that these markings were part of the normal livery of primitive trout; the inference being that, at no very distant date, all salmon, trout, and char were comprised in a single species; that the more vigorous members of the race acquired by degrees the habit of resorting to the sea for food which the fresh water could not supply in sufficient quantity; and that their changed habits and exposure to the vicissitudes of migration produced such permanent organic changes as differentiate the species. In many respects the subject remains very obscure; for example, it is not apparent why, if the explanation offered above is the true one, there should be different species of migratory salmonoid fish frequenting the same river. If these are all descended from common ancestors—trout—why are they not all true salmon, or salmon-trout, or

bull-trout?—fish that it requires only a moderate amount of experience to enable one to distinguish from each other.

On the other hand, the proposition of a common descent has received remarkable support in recent years from what has taken place in the Southern Hemisphere. Repeated attempts to establish the true salmon (*Salmo salar*) in Australasian waters have ended in uniform failure ; but the common British brook trout (*Salmo fario*) has found a congenial home in Tasmania and New Zealand, and attains a size which may well excite the envy of anglers in the old country. While writing these lines, I happened to take up the *Field* newspaper for July 26th, 1902, and extract therefrom the following as an instance in point :—

“SPORT IN NEW ZEALAND.—Early in the season I had the pleasure of a few days’ fishing with Mr. R. R. Patrick, of Beith, Ayrshire, at the Kakanui River, some sixty miles north of Dunedin. My biggest catch there for a day was twenty-six fish, the largest about 3 lb. About a month later my two boys and myself spent ten days at the same river. We caught just over four hundred fish, which averaged about a pound or a little over ; I only obtained one fish over 6 lb., but they are very game, and give lots of sport. After fishing several of the northern rivers without any blank days, I tried some of the southern ones, and had capital sport, as my note-book shows : Owaka River, fourteen fish, 22 lb., for a half-day ; following day, seven fish, 16 lb., one a nice one of 5 lb. Makarewa River, eleven fish, 18 lb. ; six fish, 11 lb. ; nine fish, 17 lb. Waikiwi River, two fish, one 7 lb., one 2 lb. These were caught in about two hours’ fishing just before dusk. Having noticed a big one rising on the wrong side of the river for me, I told a friend of mine about him. He drove out next morning a distance of six miles, and was home in time for breakfast at nine with two pictures of big brown trout ; they weighed 7 lb. each, and might have been brothers. My friend told me he caught one just where I had described noticing the

rise. My note-book shows a capital season's sport, brought to a great climax of two days on the Waiau River. This river is comparatively unknown, even to New Zealand anglers, but it is an angler's paradise. Before going, I had been advised to take extra strong gear and long line ; I thought eighty yards would do, but I required a special line of one hundred and fifty yards. It is hard to describe fishing on the Waiau. The river itself is a very big one ; I should judge it to be at least one hundred and thirty yards across, deep and swift, yet with some splendid ripples. On the night of my arrival I went out at about eight o'clock, lit a huge fire on the shingle with big driftwood, and started. My first fish was about 10 lb., and a nice job it was trying to gaff him in the flickering light from the fire. It is all very well to write about it, but I should like to see some of your readers having the fun. It is not an easy matter to land a 10 lb. trout of a fast river even in the daytime, but at night it is a caution. However, by twelve o'clock I had landed fifteen fish, weighing 104 lb., and lost four supposed to be extra strong casts ; goodness knows what size the fish were that broke my casts, but had they not broken my casts the line must have gone. The following day I caught seventeen fish, averaging 6 lb., and lost another cast, apparently in exactly the same way as overnight ; the fish took the minnow, and made straight for the opposite bank, did not go up or down stream, but straight across. With a salmon rod, and the strongest gut procurable, I could do nothing with these very big ones, but have made up my mind to find out how big they are next season, by having a line which will reach across this river. As for sport, it is not to be beaten. If any of your readers desire exciting angling, let them try the Waiau River in January or February. My experience is not by any means an unusual one ; many of the local fishermen tell the same story. —C. H. OSMOND, *Dunedin, N.Z., June 3rd, 1902.*"

A remarkable change has manifested itself not only in the

appearance, but in the habits of these fish. At first they carried red spots like their English ancestors, but these now disappear after the yearling stage, and the fish are as silvery as salmon, with the x-shaped black spots so characteristic of the migratory species. And in Tasmania these descendants of English brook trout have thoroughly acquired the sea-going habit. Large trout are only to be found in the river Leith during the winter months ; the rest of the year they spend in the sea or the estuary, where they are taken of large size in nets. Does not this seem as if the salmonoid history of tertiary and post-tertiary rivers were repeating itself under our very eyes ?

SUB-GENUS—SALMONES

The Salmon (*Salmo salar*)

FINS.

First dorsal : 14 rays.

Second dorsal : rayless, adipose.

Anal : 11 rays.

Pectoral : 14 rays.

Ventral : 9 rays.

TEETH.

Conical teeth on both jaws, all along the vomer and palatine bones, and on the tongue, none on the pteryoid bone (at the back of the palate).

Never was animal more fitly named from its habits than the salmon—"the leaper"—from *salire*, to leap ; for it cannot be long in a river without betraying its presence by throwing itself out of the water, falling back with far-resounding splash. Truly, an adult salmon, fresh from the sea, is one of the most perfectly beautiful of living creatures. Nor does it owe its beauty to gorgeous colouring or complicated form ; but to purity of silver mail, to subtle, yet simple, curvature of contour, and to that concentrated grace which consists in the perfect adaptation of every organ to a life of intense activity and energy.

But that applies only to the salmon in one of the numerous phases through which it passes, not only within the span of

its existence, but within the limits of a single year. Beginning *ab ovo*, we may trace this noblest of British fishes as a tiny The Alevin "alevin," or larva, with the relatively large umbilical stage. sac attached to the throat or breast behind the gill-opening. For a period varying from three weeks to two months, the alevin draws its nourishment from this sac; by the time this is absorbed the fish is generally about an inch and a quarter long.

It now enters upon life as a "parr," and assumes a very lively colouring. The back becomes dark olive with bronzy reflections, and this colour extends down the sides, below the The Parr lateral line, in nine or ten vertical bars, arranged upon stage. a paler ground of olive green shot with golden, coppery, and silvern hues, and liberally spangled with spots, some black, some scarlet. The lower parts are pearly white; the iris golden; the pectoral, ventral, and anal fins are tinged with orange-brown; the dorsal fins are grey, the first dorsal being dotted with black. The chief marks distinguishing a salmon parr from a river-trout at the same stage are: first, the head is shorter and rounder; second, the salmon or salmon-trout parr generally has two or three more lateral bars than the river trout parr; and third, the adipose fin of the river-trout parr is more or less deeply tinged with red, while that of the salmon parr is a light slate colour. The last-mentioned distinction cannot be relied upon in the case of the parr of migratory trout, which often have a ruddy or orange colour in the adipose fin.

It scarcely strengthens one's faith in the acumen of classifying authorities that the parr was, until very recently, unanimously regarded by them as a distinct adult species. Willughby in 1686, Ray in 1713, Pennant in 1776, Turton in 1807, Yarrell in 1836, even Couch in his edition of 1877, adduce cogent reasons, founded upon organic differences, for classing the samlet (*Salmo salmulus*) as a separate species, the smallest of British *Salmonidæ*. It is not often, perhaps, that

unlearned men of the open air find their way to the truth before those of the museum and laboratory, but in this instance practical fishermen divined the secret earliest, as may be seen from a passage in Scott's *Fair Maid of Perth*, published in 1828. "Eachin resembles Conachar," said the glover, "no more than a salmon resembles a parr, though men say they are the same fish in a different state." The question was not settled until Mr. Shaw had conducted a lengthy series of experiments in the Stormontfield ponds during a number of consecutive years from 1830 onwards. His report, printed in the *Edinburgh New Philosophical Journal*, 1836, followed by a paper he read before the Royal Society of Edinburgh in 1837, left no room for doubt as to the identity of salmon and parr, although, as above mentioned, Couch stoutly refused to adopt this conclusion.

At the age of fifteen months, the majority of salmon parr, which have lived so far like common brook-trout, feeding on insects, worms, and such-like small prey, begin to get ^{The Smolt stage.} restless, to drop out of the rivulets which have hitherto harboured them, and to congregate in shoals in the main river. Some individuals postpone this movement till they are seven-and-twenty months old, or thereby, but it is probable that a large majority prepare for the sea trip in April and May of their second spring. This movement is heralded by a remarkable change in the appearance of the fish, which now measure on an average about five inches in length. The olive green of the back turns into a bluish tint, and the gay motley of the sides, never more brilliant than at this season, is hidden by the secretion of guanin under the scales, which gives a uniform covering of brilliant silvery lustre, known to fishermen as the sea-jacket. In this new guise they make their way to the sea, where, as they divine by hereditary instinct, more abundant provender awaits them than they can find in their native streams.

We lose sight of the smolts now, and for an uncertain

period. It is generally supposed that they return to the fresh water about a year after they have left it, and this is probably true of the majority. They are now adult, but virgin, ^{The Grilse} salmon, retaining some traces of adolescence and ^{stage.} showing a considerable variation in size. Having left the river weighing but two or three ounces each, grilse begin to reappear in fresh water during May, presumably of the next year, weighing from 2 lb. to 5 lb. As the summer and autumn months pass, grilse continue to run, increasing in size as the season advances, being taken as heavy as 10 lb. and even 12 lb. It is possible that these heavy grilse may have remained two whole seasons in the sea before revisiting the river where they were hatched. Their approach to maturity and the rate of development of the ovaries in females* probably depends upon the amount of food which they find in the sea. This was formerly considered to consist entirely of crustaceans—shrimps, prawns, and the like—and to such diet was attributed the beautiful and peculiar hue, the “salmon colour” of the flesh of this fish; but recent observations have shown conclusively that salmon subsist chiefly upon herrings, haddocks, and other pelagic fish. In the spring of 1899 Dr. Kingston Barton, on opening a salmon taken at sea, found in the stomach no fewer than six large herrings, “that nearest the salmon’s mouth being barely changed in appearance, while the sixth had only the spinal column undigested, those in between being in a graduated state of digestion, and yet all these fish were in the one cavity.”† In other words, this salmon had swallowed consecutively more than any ordinary human being could attempt at a single meal! The intestines, also, were very full of faecal matter, showing that this was no exceptional indulgence. Dr. Barton adds a note of the surprising fact that both in salmon and sea-trout the food-fish is always swallowed tail first.

* Milt capable of fertilising ova is often developed in male parr before they go to sea.

† *Journal of Anatomy and Physiology*, April, 1900, p. 297.

In habits and appearance the grilse, on returning from the sea, is very similar to full-grown salmon, but persons accustomed to deal with these fish can discriminate with certainty between a 6 lb. salmon and a 10 lb. grilse. The points of difference are as difficult to define in writing as those which distinguish a girl of sixteen from a woman of thirty. The grilse is smaller round the tail than the salmon, as you will find if you try to lift it by grasping it there; the tail fin is more forked; the snout is sharper; the general form of the fish is more elegant and the scales more delicate in the grilse stage than in later periods of growth.

The salmon is what is termed an anadromous fish—that is, one that “runs up”—and it is usually stated that the purpose with which it ascends the rivers from the sea is that ^{Habits of} ~~the Salmon.~~ of reproduction. No doubt that is one motive, for salt water has been proved to be fatal to the vitality of the ova; but to represent it as the only, or even the principal, motive is to misconstrue the facts of the life-history of the fish. In certain rivers, such as the Tay, salmon run from the sea in every month of the year; in others, they begin to run regularly in the spring months—February to May; while in a third class of river they put in no appearance whatever till late in summer, or even in autumn. Now salmon appearing in “late” rivers, or appearing in the autumn in what are known as early rivers, do so in a more or less gravid condition, and may be said to be leaving the sea for the purpose of depositing their spawn; but whereas the spawning season of salmon is perfectly defined as extending from the middle of October, at the earliest, to the end of January, how can it be said that fish running in the first quarter of the year are doing so for the purpose of spawning? The question will be further considered in the next chapter.

Meanwhile, all that I wish to advance is that a portion, at least, of the spring and early summer run of salmon return to the sea long before the regular spawning season; it is clear

that salmon leaving the sea are not always acting under the reproductive impulse.

This is no matter for dogma, but the explanation of the periodical movement of salmon which most nearly corresponds with my own observation is as follows.

Like many of the lower vertebrate animals, especially fish, salmon manifest intermittent periods of appetite during which growth proceeds, and of abstinence, during which growth is suspended.* The salmon feeds and grows without intermission through the stages of alevin, parr, and smolt, and continues to do so in the sea in its transition to the grilse stage. Under the stimulus of unlimited nutrition, the fish rapidly increases in bulk, until the time comes when its tissues are so fully stored with fats and proteids, that no more nourishment can be assimilated, appetite ceases, and the fish returns to its native river. There is no evidence to connect the return of grilse in May, five or six months before the spawning season, with the sexual impulse. It appears probable that, the purpose with which the fish visited the sea having been accomplished, it simply returns home, *i.e.*, to its native fresh water, which is its most congenial environment. After an uncertain period, appetite may return, and the fish obeys the impulse to seek again the salt water, teeming with various forms of life offering an abundance which cannot be found in the river.

* As an extreme instance of periodical fasting and arrest of growth, the so-called lepidosiren (*Protopterus annectens*) may be cited. This fish, which belongs to the Ganoid Order, abounds in many rivers of tropical Africa. These rivers usually disappear in the dry season, when the fish bury themselves in the mud, lining their resting-place with a protecting case of mucus. The mud-balls thus formed may be dug out and have been brought to Europe, where the fish inside can be released by immersing their domicile in tepid water. Here it is obvious that there must be absolute abstinence from food for long periods, and the rigid envelope renders the corresponding cessation of growth a necessary consequence of the situation.

Another agent suggests itself as possibly prompting the return of a fresh-water fish to the river—namely, thirst. Salt water is not the native atmosphere of salmon; they endure it for a while without inconvenience, but the time may arrive when they can endure it no longer, and they may then dare every difficulty to reach the refreshing currents of their native stream. This can never be more than a hypothesis, and as such is worth but little; nevertheless it is a question not to be dismissed as trivial, whether vertebrate animals born and reared in fresh water can inhale and swallow a strong solution of salt without experiencing some of the symptoms which are familiar to ourselves.

There is a marked difference between the determination of a spring salmon and a gravid autumn fish in overcoming obstacles to their ascent of a stream. In many ^{Salmon} ^{leaps.} rivers, a very moderate fall serves to deter fish in the early months; whereas when the spawners are keen to get to the "redds" it is surprising what difficulties they will overcome. A good example of this is afforded by the Helmsdale, a river without nets or artificial impediments to the ascent of salmon, reserved exclusively for sport with the rod, and therefore an admirable field for studying the habits of these fish. Salmon run into this river continuously from New Year's Day throughout the season, and the lower eight miles of water often contain a very heavy stock before the end of March. But at this distance above the sea there are the rocks of Kildonan, where the river tumbles over a very moderate fall. Small as it is, this fall serves to bar the passage of spring salmon. No fish is ever seen to attempt it until the middle of April; after that, they ascend it in hundreds as easily as you or I go upstairs to bed. Far more formidable obstacles than Kildonan Fall are negotiated by fish in other rivers determined to reach their spawning-ground, and in some places many are killed by leaping out upon the rocks. Nevertheless the leaping powers

of salmon have been the subject of gross exaggeration, owing to one writer blindly repeating the statements of another. Thus it is certain that Professor Seeley, usually a conscientious witness, was not speaking from his own observation when he described the limit of their perpendicular spring as "about twelve or fourteen feet." I have watched hundreds—thousands—of salmon and grilse leaping at falls, and I agree with Dr. Day that "a clear jump of six feet" is the maximum of a salmon's performance. A *sheer* fall of seven feet is an effectual bar to the ascent of salmon.

The question whether salmon feed in fresh water is the nucleus of a controversy which there seems no prospect of bringing to an early conclusion. On the one hand is the belief of many anglers that they do ^{Do Salmon feed in fresh water?} so, supported by the fact that salmon take not only artificial flies, cunningly but arbitrarily fashioned to meet their hypothetical taste, but worms, prawns, and minnows. On the other hand there is the all but universal failure to discover food in the stomach, or traces of food in the bowel, of salmon taken in fresh water. Those rare instances in which the remains of food have been so found, have occurred only in the examination of kelts—that is, salmon returning to the sea after spawning. Yet if the voracity with which the hungry aspect of kelt salmon has caused them to be credited were well founded, such remains of food ought to be present in almost every kelt examined. The well-recognised phenomenon of the absence of all trace of food in the stomach and intestines of salmon taken in fresh water has led persons who decline to believe in a physiological fast to account for it by a purely hypothetical power inherent in the salmon of ejecting the contents of both stomach and intestines immediately upon being hooked or netted. Needless to say that such an explanation, in the complete absence of any evidence to support it, is worth no more consideration than ought to be shown to any *a priori*

doctrine. No advance in knowledge is possible on such lines, which, on the contrary, must tend to the darkening of understanding.

Those who hold to the belief that salmon feed in our rivers should reflect upon the depleted state of the salmon population. Industrious netting has brought the stock to a low ebb; were the fish as numerous now as they were in primitive times—as they are now in some of the rivers of the Pacific coast of America—what prospect would they have of subsistence in a hungry Highland river, where even the common trout display evidence of very meagre fare? Last year, during the great drought of July (1901), I lay on the rocks beside a deep but narrow “linn” on a Scottish river, and counted upwards of sixty salmon and grilse congregated there. The water was crystal clear; I could detect every movement of the fish, and specially took note of the action in performing a leap, as from time to time a fish would throw himself out of the water. Presently I noticed a couple of very small trout swimming unconcernedly over the backs of the great fish below, snapping at flies, and manifesting a sense of the utmost security. “My little friends!” was my soliloquy, “a sorry look-out it would be for you if salmon sought for food in fresh water.”

No: it is contrary to the lessons of dispassionate observation, to common sense, and to the results of physiological research, to doubt that the normal condition of salmon, after they leave the sea and until they return to it, is one of fasting. The predaceous instinct and habit disposes them to seize, at capricious intervals, lifelike moving objects, such as artificial flies or spinning baits; spasms of gourmandise induce them, also at capricious intervals, to seize and mumble such savoury morsels as worms or prawns; but never has any man beheld salmon in quest of prey in a river.

The case of the Canadian ouananiche and of the “land-



Photo by P.D.Malloch

$\frac{1}{2}$ Natural Size

THE SALMON IN SPRING (*Salmo salar*)

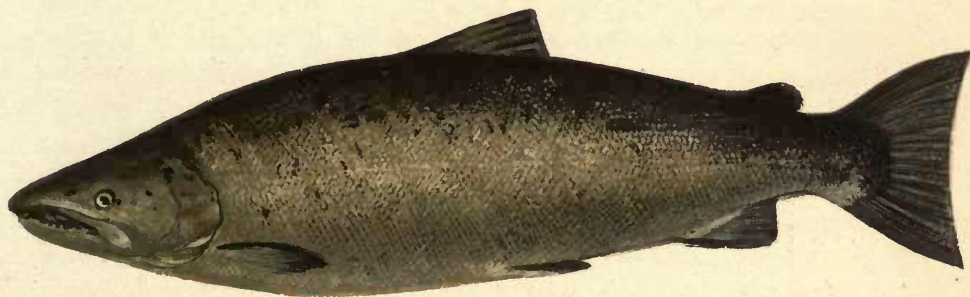


Photo by P.D.Malloch

$\frac{1}{2}$ Natural Size

THE SALMON IN AUTUMN (*Salmo salar*)



Photo by P.D.Malloch

$\frac{1}{2}$ Natural Size

THE BULLTROUT (*Salmo eriox*)



locked" salmon of Lake Maine in the United States and of Lake Wenern in Sweden must not be overlooked. These fish have been pronounced by competent ichthyologists to be specifically identical with the true Atlantic salmon.* They never descend to the sea, and necessarily find their sustenance in fresh water. Their requirements are met by the resources of great inland sheets of water, into which they resort for food, and whence they ascend the rivers to spawn.

We must now return to the point where we left the grilse or salmon. When it first leaves the sea its silver mail is of spotless purity; but a sojourn of two ^{Seasonal change in appearance.} or three weeks in the river, especially if the air and water temperature be high, suffices to dim the lustre of its scales. The cause of this change and its process are far from being thoroughly understood. Popularly it is believed to be brought about by exposure to sunlight and by the fresh water acting as an oxidising agent; but there is this consideration to be taken into account, that, as soon as the salmon has spawned, and becomes what is known as a "kelt," the discoloration begins to pass away, and before the fish regains the salt water it has become quite as silvery as when it left it. Moreover, as we have seen, the parr in passing into the smolt stage, before ever it has tasted salt water, puts on a bright silvery coat. All this seems inconsistent with any supposed oxidisation by the river water. We are dealing, not with real silver, nor any mineral, but with an organic substance known as guanin

* The epithet "land-locked" is most misleading and ought to be discontinued. It is easy enough to provide obstacles against the ascent of a river by salmon; not so to prevent their descent. In Labrador ouananiche are found above falls one hundred feet in height. In descending such a cascade, many fish might be killed; but how could a salmon, which will exhaust himself in efforts to *ascend* an impassable fall, estimate the danger of *descending* one, and decide that it were safer to remain above?

(see page 158). A more probable explanation of the change of skin colour which takes place after the salmon enters fresh water will be submitted in the next chapter. In most teleosteous fish—the carps and pike, for instance—the beauty of colour culminates at the spawning season, as if the different sexes took pleasure in the brilliancy of each other. It is difficult, for instance, to imagine a female stickleback of so phlegmatic a nature as not to derive excitement from the bridal raiment of her spouse. But salmon, male and female, so far from acquiring enhanced comeliness at this critical season, become positively unsightly. The male turns to a deep coppery brown; the burnished silver of his mate is deeply tarnished with exactly the same tints as sulphurous fumes impart to the real metal. Her snowy throat and underparts are smeared and stained with the same sooty hue, and her once perfect form distended by the swollen ovaries. Both sexes lose their crispness to the touch, and become covered with slime.

As if this disguise were not enough, the male assumes as it were an ugly mask. When salmon of less than 10 lb. or 12 lb. in weight leave the sea the heads of the two sexes are indistinguishable from each other;* but as the milt grows in the male so do his snout and lower jaw, and at the end of the lower jaw a knob grows upon the upper edge of the mandible, forming a pronounced hook, which, in old males, fits into a recess in the snout when the mouth is closed. This characteristic hook is neither cartilaginous nor bony, but is formed entirely of cutaneous connective

* I am quite aware that experienced fishermen profess to distinguish between newly-run male and female fish by the shape of their jaws, but I have adduced evidence on page 237 to show that it is impossible to do so early in the season, before the generative apparatus of the fish has advanced towards maturity. It is difficult, perhaps impossible, to convince fishermen of this, and indeed in *very old males* the base of the temporary hook formed on the mandible becomes bony, and the jaws remain longer than those of females, thereby affording a permanent indication of sex.

tissue, an outgrowth of the general envelope of the body which underlies the epiderm or outer skin. Of the purpose of this peculiar excrescence it boots not to treat, though there be many who have done so. Various functions have been assigned to it on purely speculative grounds. Some would have it to be a weapon of offence ; but it seems to be the very reverse of this, diminishing the destructive power of the jaws by partially closing the mouth. All we really know about it is that it appears on the males periodically at the breeding season, and is re-absorbed when the reproductive function is finished and the fish becomes a kelt. In old males, this knob is never completely absorbed, and the head becomes permanently elongated in comparison with that of the female. But it is to be noted that occasionally females develop the knob also, though not to such an extent as the males.

One use often, but erroneously, ascribed to the knob or hook, is that of preparing a nest or bed for the spawn ; and **Process of spawning.** it shows how difficult it is to stamp out an error which has once received currency that people may still be heard repeating this silly fable. So long ago as 1656, Richard Franck, as observant in zoology as he was bitter in theology, accurately described the process of spawning as he himself had watched it. The female swims upon a gravelly shallow, where the current is brisk, but not violent ; and, having chosen a spot to her fancy, rolls upon her side and flaps her tail rapidly so as to fan up the gravel, thereby excavating for herself a hollow. This trough is usually called a "redd"* in the north, and when the fish have not been delayed by want of floods from ascending the river, several days may be occupied in making it ; but when salmon have been retarded by drought in arriving at the spawning-ground, the redd is excavated in more summary fashion. So soon as it is finished

* *I.e.*, a place made "ready" or prepared. "Redd me a place" in Lowland Scots means "Prepare room for me."

the female deposits such of her ova as are ripe for shedding, beginning, it is said, at the lower end of the trough. The male moves up and sheds his milt upon them, and, as the fish work up stream, the action of their fins and tail bury the eggs as fast as they are impregnated. This process is repeated daily until all the ova are deposited. Generally there are a pair of salmon, male and female, of about equal size on each redd ; but in addition to these, smaller males hang about, endeavouring to snatch an occasion for cutting in. The result has been described by several observers as a series of fierce tiltings between the rivals, many of whom lose their lives in combat.

The period of spawning varies slightly according to latitude, fish in the extreme north of Scotland being from a fortnight to a whole month in advance of those in rivers further south. Thus in the autumn of 1899 the first salmon were seen upon the redds of the Tay on November 1st, of the Forth on November 8th, of the Helmsdale on October 10th, and of the Findhorn on October 17th. The months when the majority of salmon spawn in most rivers are those of November and December.

The spawn is exposed to many accidents after it has been deposited in the redds in the manner described. Trout, eels, and coarse fish eat the ova greedily ; in fact, salmon roe is known to be such a deadly bait for trout that its use has long been prohibited by law. Birds and water insects of several species prey on this succulent fare ; pollution, especially of a sedimentary nature, is very hurtful to the ova ; but perhaps the greatest destruction of all is wrought by ice in very hard winters. It is not that the eggs are destroyed by cold ; they will stand exposure to a very low temperature ; but the ground ice, which is formed in running water by severe frost, rises when the fresh comes, carrying with it masses of gravel and all that it contains. Nature, as usual, has counterbalanced the risks of destruction by the fecundity of

the parents. The late Frank Buckland reckoned that a female salmon produced about nine hundred eggs to every pound of her gross weight ; thus a fish of 20 lb. should contain 18,000 ova. The period which intervenes between deposition and hatching varies according to temperature. Mr. Armistead, of the Solway Fishery, says that he has known the eggs to be hatched in thirty days, but in very cold water this may be deferred as long as 160 days. When first extruded, the ova adhere to each other, but in the course of an hour or two they separate, each becoming a round independent globe, of a bright orange colour, the size of a small pea, and enclosed in an elastic envelope. For a period of from twenty-four to forty-eight hours after impregnation the ova may be freely handled, and will bear transport ; but after that they become exceedingly sensitive of disturbance. Mr. Armistead mentions an instance in point which occurred in his hatchery. A tray of eggs received a slight concussion nine days after impregnation ; the result was that 25 per cent. were picked out dead within a few days. With proper care and suitable appliances the percentage of loss by death between impregnation and hatching ought not to exceed 5 per cent.

About halfway through the period of incubation two little dark dots appear in each egg—the eyes of the embryo ; after which the ova can be moved and handled with impunity, always premising that they are not exposed to a higher temperature than 45° Fahrenheit. Subject to this precaution, “eyed ova” may be sent long distances by road or rail without detriment.

Anxiety is often expressed by persons interested in salmon-fisheries for the fate of spawn deposited in comparatively shallow water during floods ; but this matter they may safely leave to that mysterious form of sagacity which we describe as instinct. In no part of the business of living is this secret power more manifest among wild animals than in provision for their young. Low as they stand in the scale of vertebrate

animals, feeble as we must judge their intelligence to be, careless as they appear in sowing their spawn broadcast to the mercy of the seasons—yet salmon understand the business of reproduction. It is true that the redd is sometimes made in such thin water that it is laid dry in time of drought. Dr. Day quotes Mr. Brander as having examined a redd in such a condition. He found plenty of moisture under the gravel, and “having scraped a hole, he obtained a considerable number of eggs, which he transferred to a pail of water, where two-thirds hatched within periods varying from five minutes to twenty-four hours. About a week later he returned to the spot, and had another dig for salmon eggs, no rise having occurred in the river during the interval. He collected more, and put them in water, when they hatched as the others had done.” It seems, then, that when a redd is laid dry on the surface, the hatching is retarded until such time as the water overflows it again, when the fry come out quickly.

The effort of spawning is an extremely exhausting one, and could scarcely be otherwise, seeing that the ovaries are often one-fifth or even one-fourth the total weight of the female. Yet it is not among the females that the subsequent mortality is greatest. Both sexes, after spawning, drop back into still, deep water to recruit. They are exceedingly emaciated, and between this time and their return to the sea are known as kelts, and are protected under various statutes. Their skins retain for a short time only the dark tints they acquired before the breeding season ; gradually, but rather quickly, these fade away, and the scales regain the silvery lustre of the sea fish. Kelts are very uncertain in the rate of their progression to salt water. Some fish drop down and disappear immediately after spawning in November and December ; others linger long in the pools, and may be encountered by anglers throughout the spring months. Their lean forms, coupled with the pertinacity they sometimes show

in taking the artificial fly and other baits, have brought them into evil repute with riverside folk, who accuse them of devouring the young of their own kind, and advocate the repeal of the statutory provision for their protection. This would be disastrous to the interest of the salmon-fisheries. A kelt is an adult salmon, and when we try to calculate the odds against the contents of any individual ovum reaching that stage of growth, it is surely apparent that kelts are worth the most sedulous care, unless it can be proved that they are the enemies of their own race. Long and careful examination by scientific methods, conducted simultaneously in Germany and Great Britain, has shown that it is the rarest thing possible to find the remains of food in the stomach or intestines of kelts, or, indeed, of salmon at any stage of growth subsequent to the smolt, so long as they are in fresh water. Moreover, trout, pike, and other predaceous fish which inhabit our inland waters may easily be seen by observant persons in pursuit of their prey. Who ever detected a kelt salmon doing the like? If they devoured parr and smolts, would they not frequent those parts of a river where the immature fish were to be found? They do not do so. Kelts, it is well known, lie in deep pools, and may never be seen prowling about the shallows where smolts and parr congregate. No; the assumption that kelts commit ravages upon young of their own kind is a false inference from the hungry appearance of the fish; they *must* eat something, say their traducers, and in many salmon rivers there is no food for them in the spring months except a few small trout and multitudes of parr and smolts, whence these incautious reasoners leap to the conclusion that kelts live upon small trout and smolts. All the evidence on this subject that will bear analysis points to this, that from the moment a salmon enters a river it ceases to feed; henceforth the source of muscular energy and of supplies for the growing genitalia exists in the enormous accumulation of fats and proteids laid up in the muscular tissue during the marine excursion.

Izaak Walton, albeit he knew little or nothing at first hand about the salmon, had been told what modern research has confirmed, namely, that "his growth is very sudden ; it is said that, after he is got into the sea, he becomes, from a samlet not so big as a gudgeon, to be a salmon in as short a time as a gosling becomes a goose. Much of this has been observed by tying a riband, or some known tape or thread, in the tail of some young salmon which have been taken in weirs as they have swimmied towards the salt water ; and then by taking a part of them again, with the known mark, at the said place, at

Rate of growth of migratory Salmonoids, their return from the sea, which is usually about six months after." But it is only of late years that trustworthy data have been accumulated whereon any sound estimate could be based as to the rate of growth in salmon and their kin after their first descent to the ocean. These data have been collected and tabulated by Mr. W. L. Calderwood, and published in the Report of the Fishery Board for Scotland, Part II., for 1901, forming a most valuable source of information for all persons interested in the question. Space can be found here only for a brief reference to this paper. The following are a few out of a large number of fish captured as kelts and recaptured as clean fish, recorded—1st, by Mr. Young, of Invershin, in the years 1841-2 ; 2nd, by the late Duke of Atholl, in the Tay, 1854-9 ; 3rd, by the Tweed Commissioners, 1854-70 ; 4th, by Mr. Walter Archer, Inspector of Salmon-Fisheries in Scotland, under the system initiated by him in 1896, and continued by his successor in office, Mr. Calderwood, from 1898 to the present time ; 5th, by a gentleman on the Hampshire Avon, who has communicated his observations to the *Field* newspaper.

Mr. Calderwood reports that, at the close of 1901, out of 2,976 fish recently marked in ten Scottish rivers, 190 had been retaken and the particulars thereof recorded.

KELTS RECAPTURED AS CLEAN FISH.

River.	Date of Marking.	Condition and Weight.	Date of Recapture.	Condition and Weight.	Observations.
Shin	Feb. 18, 1841	Grilse kelt, 4 lb.*	June 23, 1841	Salmon, 9 lb.	Increase 125 per cent. in 4 months 5 days.
"	"	" "	June 25, 1841	Salmon, 11 lb.	Increase 175 per cent. in 4 months 7 days.
"	" "	" "	" "	Salmon, 9 lb.	Increase 125 per cent. in 4 months 7 days.
"	" "	" "	" "	Salmon, 10 lb.	Increase 150 per cent. in 4 months 7 days.
"	" "	" "	July 27, 1841	Salmon, 13 lb.	Increase 225 per cent. in 5 months 9 days.
"	" "	" "	July 28, 1841	Salmon, 10 lb.	Increase 150 per cent. in 5 months 10 days.
"	March 4, 1841	" "	July 1, 1841	Salmon, 12 lb.	Increase 200 per cent. in 3 months 27 days.
"	" "	" "	" "	Salmon, 14 lb.	Increase 250 per cent. in 3 months 27 days.
"	" "	" "	July 27, 1841	Salmon, 12 lb.	Increase 200 per cent. in 3 months 23 days.
"	Jan. 29, 1842	" "	July 4, 1842	Salmon, 8 lb.	Increase 100 per cent. in 5 months 6 days.
"	" "	" "	July 14, 1842	Salmon, 9 lb.	Increase 125 per cent. in 5 months 16 days.
"	" "	" "	" "	Salmon, 8 lb.	Increase 100 per cent. in 5 months 6 days.
"	March 8, 1842	" "	July 23, 1842	Salmon, 9 lb.	Increase 125 per cent. in 4 months 15 days.
"	Jan. 29, 1842	" "	July 29, 1842	Salmon, 11 lb.	Increase 175 per cent. in 6 months.
"	" "	" "	Aug. 11, 1842	Salmon, 12 lb.	Increase 200 per cent. in 6 months 11 days.
"	March 8, 1842	" "	Aug. 4, 1842	Salmon, 10 lb.	Increase 150 per cent. in 4 months 27 days.
Tay	March 21, 1854	Kelt, 11 lb.	Aug. 24, 1854	Taken in net near Montrose, 17 lb.	Increase upwards of 50 per cent. in 5 months 3 days.
Tweed	May, 1854	Smolt, 1 oz.	July, 1855	Grilse, 3½ lb.	Increase 5500 per cent. in 14 months. Marked with wire in tail fin.
"	May 15, 1857	Bull-trout smolt	May 25, 1858	Bull-trout, 3 lb.	Marked with silver wire in upper jaw.
"	" "	Salmon smolt	Aug. 9, 1858	Grilse, 3½ lb.	Marked with silver wire in upper jaw.
"	" "	Bull-trout smolt	Aug. 28, 1858	Bull-trout, 3¼ lb.	Marked with silver wire in upper jaw.
"	March 31, 1858	Kelt grilse, 2 lb.	Aug. 2, 1858	Salmon, 8 lb.	Increase 300 per cent. in 4 months 2 days.
Tay	Feb. 14, 1859	Kelt, 10 lb.	Aug. 18, 1859	Salmon, 17 lb.	Increase 70 per cent. in 6 months 4 days.

* It is to be noted that Mr. Young, of Invershin, in marking these grilse (manner of marking not specified) put down all grilse kelt at the uniform weight of 4 lb.

River.	Date of Marking.	Condition and Weight.	Date of Recapture.	Condition and Weight.	Observations.
Tay	March 2, 1859	Kelt, 11½ lb.	Aug. 18, 1859	Salmon, 17 lb.	Increase about 50 per cent. in 5 months 16 days.
"	March 29, 1859	Kelt, 12½ lb.	Aug. 12, 1859	Salmon, 19 lb.	Increase about 45 per cent. in 4 months 14 days.
"	Feb. 25, 1861	Kelt, 13 lb.	Aug. 11, 1862	Salmon, 26 lb.	Increase 100 per cent. in 17 months 18 days.
Tweed	Sept. 29, 1870	Clean salmon-trout, 1¾ lb.	July 26, 1872	Clean salmon-trout, 2½ lb.	Increase about 45 per cent. in 21 months 27 days.
"	Oct. 13, 1870	Bull-trout, 2 lb.	Aug. 15, 1871	Bull-trout, 2 lb.	This fish had increased 2½ in. in length in 10 months 2 days, but was of the same weight.
"	" "	Bull-trout, 3¼ lb.	Nov. 30, 1871	Bull-trout, 4 lb. 13 oz.	This fish was recaptured in the Coquet. Increase about 30 per cent. in weight and 4 in. in length in 13 months 17 days.
Brora	Feb. 11, 1896	Kelt, 6 lb.	April 7, 1897	Salmon, 14 lb.	Increase 130 per cent. in 13 months 26 days.
Helmsdale	Feb. 12, 1896	" "	July 15, 1896	Salmon, 16 lb.	Recaptured in the Brora. Increase 160 per cent. in 5 months 3 days.
"	Jan. 18, 1896	Kelt, 5 lb.	" "	Salmon, 10 lb.	Recaptured in the Brora. Increase 100 per cent. in 6 months.
"	Jan. 29, 1896	Kelt, 4½ lb.	April 10, 1897	Kelt, 8 lb.	Increase nearly 90 per cent. in 15 months 11 days.
Brora	Feb. 12, 1896	Kelt, 8 lb.	Aug. 24, 1896	Salmon, 14 lb.	Increase 75 per cent. in 6 months 12 days.
"	March 9, 1896	Kelt, 9 lb.	Aug. 18, 1896	Salmon, 13 lb.	Increase about 40 per cent. in 5 months 9 days.
Spey	Feb. 14, 1896	Kelt, 6 lb.	April 23, 1896	Salmon, 9 lb.	Increase 50 per cent. in 2 months 9 days.
Brora	March 30, 1897	Kelt, 5½ lb.	March 3, 1898	Salmon, 13 lb.	Increase about 120 per cent. in 11 months 27 days. It seems scarcely possible that this fish can have spawned in the interim.
"	" "	Kelt, 6 lb.	July 16, 1897	Salmon, 8 lb. 2 oz.	Increase about 34 per cent. in 3 months 16 days.
"	" "	" "	Feb. 18, 1898	Salmon, 14 lb.	Increase about 133 per cent. in 10 months 10 days.
Helmsdale	March 30, 1899	Kelt, 5 lb.	July 31, 1900	" "	Increase about 180 per cent. in 15 months.
Blackwater (Kenmare)	Dec. 13, 1900	" "	July 15, 1901	Salmon, 9½ lb.	Increase nearly 100 per cent. in 7 months.

River.	Date of Marking.	Condition and Weight.	Date of Recapture.	Condition and Weight.	Observations.
Burrishoole (Ireland)	March 12, 1900	Kelt, 4 $\frac{3}{4}$ lb.	July 12, 1900	Salmon, 8 $\frac{3}{4}$ lb.	Increase about 90 per cent. in 4 months.
Moy (Ireland)	Feb. 19, 1901	Kelt, 4 lb.	July 12, 1901	Salmon, 6 lb.	Increase 50 per cent. in 4 months 21 days.
Tay	Feb. 11, 1901	Kelt, 8 lb.	March 5, 1902	Salmon, 19 lb.	Increase about 130 per cent. in 1 year 22 days.
Brora	April 20, 1901	Kelt, 3 lb.	July 17, 1901	Salmon, 8 $\frac{1}{2}$ lb.	Increase nearly 200 per cent. in 109 days. This fish was recaptured in Bighouse Bay, Halladale, 70 miles from Brora Mouth.
Deveron	Feb. 8, 1902	Kelt salmon-trout, 3 lb.	July 19, 1902	Clean salmon-trout, 6 lb.	Increase 100 per cent. in 5 months 11 days.
Avon (Hants)	Feb. 9, 1893	Kelt, 15 lb.	Feb. 15, 1894	Spring fish, 33 $\frac{1}{4}$ lb.	Increase of 18 $\frac{1}{4}$ lb. in 1 year 6 days.
Avon (Hants)	March 22, 1893	Kelt, 8 lb.	March 15, 1894	Spring fish, 21 $\frac{1}{4}$ lb.	Increase of 13 $\frac{1}{4}$ lb. in 358 days.
Avon (Hants)	March 1, 1893	Kelt, 6 lb.	April 3, 1894	Spring fish, 20 lb. 10 oz.	Increase of 14 lb. 10 oz. in 13 months.
Avon (Hants)	March 27, 1893	Kelt, 8 lb.	April 14, 1894	Spring fish, 25 lb.	Increase of 17 lb. in 1 year 18 days.
Avon (Hants)	March 17, 1893	Kelt, 7 lb.	May 3, 1894	Spring fish, 23 lb.	Increase of 16 lb. in 13 months 16 days.

From these returns, which may be welcomed as a very instructive instalment of what may be expected as the result of the extensive and systematic observation and markings of fish now being carried on under the Scottish Fishery Board, it is abundantly clear that the growth of salmon in the earlier stages—from smolt to grilse and from grilse to salmon—is exceedingly rapid, but, as might be expected, far from uniform, depending, no doubt, partly on the constitution of the individual, on its power of assimilating nourishment, and partly on its success in finding abundance. Especially interesting are Nos. 18, 19, 20, and 21 in the above list, recording the recapture of marked smolts, showing an increase of as much as 5500 per cent. in weight within fourteen months. It will be remarked that all these smolts were recaptured as *small* grilse, whence it may be inferred that *large* grilse from 5 lb. to 10 lb. have remained two whole seasons in the sea without

returning to the river to spawn, for by the act of spawning the fish ceases to be a grilse.

Some light has been thrown by these observations upon the question whether salmon always return to their native river. The answer, so far as it has been received, is "Generally, but not invariably." Mr. Calderwood gives eighteen instances* of fish recaptured in the same river after the lapse of at least one season, and four in which fish were recaptured in other rivers. Only one of these had travelled to a distant river—namely, one taken as an unspawned female in the Spey at Fochabers on December 14th, 1896, marked, returned to the water, and retaken as a kelt on February 22nd following in the Aberdeenshire Dee. The mouths of these two rivers are ninety miles apart.

Out of sixty-seven instances of fish captured twice within the same river at intervals varying from 35 to 137 days, without having revisited the sea in the interval, in sixty-two cases there was a loss of from 2 lb. to $\frac{1}{4}$ lb. in weight, and in five cases only no change in weight was recorded. This bears on the vexed question about salmon feeding in fresh water, and, contrasted with their proved rapid increase in salt water, seems nearly conclusive against their taking nourishment after they have quitted the sea.

Fish culture has made considerable advance in this country during the last half-century, and salmon hatcheries have been

Artificial erected in various parts of the United Kingdom.
incubation. It would be foreign to the purpose of this book to enter upon a technical dissertation upon the management of these ; but it may be remarked that fish of the Salmon Family

* Nineteen in all, but in one of these the fish, an unspawned male of 30½ lb., was handled in spawning operations unsuccessfully, marked, and returned to the Spey at Fochabers in December, 1896. In March, 1897, the same fish was retaken in the Deveron weighing only 28 lb., and was still not fully spent. It is probable the fish had been injured in the attempt to use him for the hatchery at Fochabers.

lend themselves more readily to artificial propagation than do most others. First catch your salmon, male and female, and the operation of gently pressing the ova out of the one and impregnating it with the milt of the other is almost as simple as gathering gooseberries. In both cases you must be careful not to take what is unripe. All the contents of a salmon's ovary never are ready for shedding at the same time ; if you strip more than will come away with gentle pressure, you injure the fish beyond recovery. Neither is there a very intricate mystery in the subsequent management of the ova and the resulting fry. Even temperature, scrupulous cleanliness, an unfailing supply of pure water, and constant attention to the removal of dead or unsound eggs, is nearly all that is required to ensure an abundant hatch of alevins, which can be reared and fed as easily as so many minnows. But to turn fry, as soon as they have absorbed the umbilical bag, into the river they are intended to replenish, is to expose them at their most defenceless stage to the rapacity of innumerable foes. Yet this is too commonly the practice. It cannot be impressed too strongly upon owners of salmon-fishings that the labour of collecting and hatching ova is labour wasted, unless the fry are afterwards reared, protected, and fed in suitable ponds until they are ready to go to the sea. This adds tenfold to the expense and scale of the undertaking, and it becomes a question, whereon opinions greatly differ, whether the money and labour expended would not produce better results if applied to the protection of fish on the natural spawning-grounds. The considerations in favour of artificial propagation are as follows :—

1. The assurance that all the ova are effectively fertilised. The extent to which this is secured under natural conditions has been the matter of some doubt, and is hardly capable of demonstration. Personally, I am not disposed to distrust the scheme of Nature, which provides so effectively and elaborately for the fertilisation of all animal and vegetable ovaries.

2. The protection of the fertilised ova from ice, floods, and destruction by predaceous animals of many kinds. About the superior results of artificial hatching in this respect there can be no doubt whatever. From 90 to 95 per cent. of the ova laid down may be expected to hatch under careful management, whereas in the natural beds it is impossible to calculate the proportion that may be devoured or otherwise destroyed during incubation.

3. The protection of the alevins during the tender period while the umbilical bag is being absorbed, when they are as defenceless as eggs themselves, and in the further stage of fry. In this point also the advantage is all on the side of artificial culture, but the ultimate benefit to the fishery depends almost entirely upon whether the fry are turned loose at once or protected during a second winter until ready to make their migration to the sea.

4. The certainty of a full and constant hatch of fry independent of such conditions as scarcity of spawners, severe winters, and other untoward circumstances. In this the advantage certainly is with the hatchery.

The objections to artificial propagation are as follows :—

1. The disturbance of the spawning beds by netting the spawners. This is a very serious consideration. Every well-managed hatchery should be provided with the means of taking fish before they go on the redds, impounding them in suitable tanks or pools, where they may lie quiet until ready to shed their spawn. Fish spawning on the natural ground should be disturbed under no circumstances whatever.

2. The depletion of the natural stock of a river in order to substitute a stock reared artificially, and consequently less capable of encountering the vicissitudes of salmon life. I do not regard this objection as of any weight. The depletion caused by stripping spawners is amply compensated for by the far greater number of young brought safely through the egg, alevin, and fry stages ; and, in the parallel case of hand-reared

partridges and pheasants, the animals show no inferiority to wild ones in their powers of self-protection.

Balancing the pros and cons upon this important question, the conclusion to which most men have come after giving full consideration to the problem is that a hatchery, conducted on such an adequate scale as will ensure the annual dismissal of a large number of smolts to the sea, must be of direct advantage to the fishery, provided the ova can be secured without disturbing the fish on the natural spawning beds. But anybody who has witnessed the vast numbers of smolts, born and reared without the aid of man, which descend our rivers every spring, must be driven to the conclusion that, in order to have any appreciable effect upon the stock of salmon, artificial hatching must be conducted upon a very extensive scale. German pisciculturists conduct their operations upon a calculation that, out of every thousand smolts which are liberated, three may return to the river as adult salmon. Therefore in order to increase the run of salmon by one hundred fish in a season four or five years hence it is necessary that 300,000 smolts should be reared and set free. It is certain that this is far beyond anything that can be undertaken by any existing hatchery in the United Kingdom. It would tax the resources of any one of them to liberate as many fry, which, as I have endeavoured to show, is a fruitless proceeding. I am of opinion, therefore, that the money at present spent in salmon-hatcheries in this country would be better applied in providing protection to spawning fish, and in constructing dams on natural lakes for the purpose of flooding the rivers in time of drought to enable fish to ascend to the upper waters.

In connection with the artificial propagation of salmon, reference may be made to the experiment at present in progress for restoring salmon to the Thames, where at one time they abounded. Two causes combined to effect the extirpation of this valuable fish in the principal English river—first, the erection of navigation weirs

Restoration
of Salmon to
the Thames.

at the end of the eighteenth century; and second, the inordinate pollution of the tidal part of the river.

The first of these causes still exists in full force, but there is no reason to doubt that, were salmon to be seen attempting to pass over Teddington Weir, the Conservancy would acknowledge their obligation to erect passes over all such obstacles. This, then, is a remediable difficulty. The second, to those who remember the condition of the river from Chelsea downwards five-and-twenty years ago, might well seem insuperable. The pollution by sewage and refuse of all kinds culminated about the beginning of Queen Victoria's reign in the discharge of the waste from gasworks, and the channel continued to get worse for several years, until all men declared it to be intolerable. The stench from the river along the terrace of the Houses of Parliament was overpowering and nauseating. Below Westminster Bridge a dark, malodorous fluid ran at low tide between exposed flats of black sludge. All that is now changed. By the joint and energetic action of the Thames Conservancy and the London County Council the Thames estuary is as pure as any salmon river need be. Of course the water is turbid, as is always the case in alluvial estuaries, but there is neither organic nor mineral matter in suspension to cause any injury to fish life. I can testify to this from personal inspection of the river from Westminster Bridge to Barking Creek. The black mud flats have disappeared; the river margin, where clear of buildings, consists of bright flint gravel, clean sand, or ordinary alluvial mud. Why, then, it may be asked, have salmon not returned of their own accord? The answer is that there is still a formidable obstacle to their entrance from the sea, arising out of the very means which have been adopted to cleanse the river of sewage. London sewage, as is well known, is pumped up at various stations within the town to such a level as will cause it to flow down to Barking. At Barking it is dealt with by precipitation; the solid deposit and flocculent matter being removed and carried

out to sea in hops to the amount of many millions of tons per annum. The residuum is allowed to flow into the estuary, clear and almost scentless. But the process of precipitation and deodorisation has removed all oxygen from this effluent, thereby rendering it unfit to maintain fish in life. When there is plenty of land-water coming down the river, the effluent from Barking is carried out to sea, and speedily becomes reoxygenated. But in times of drought, when the overfall at Teddington Weir falls far short of the minimum of 200,000,000 gallons a day recommended by Lord Balfour's Commission, the river has no weight to carry out to sea the effluent at Barking, which then forms a column of water, several miles long, destitute of that oxygen upon which animal life depends. This impenetrable column, moving to and fro with the tide, effectually bars the river mouth to the ascent of salmon until a flood comes to remove it. The thermo-bacterial system of sewage treatment, which creates an effluent capable of sustaining fish life, is already employed at Barking in dealing with a small proportion of London sewage. It remains to be seen whether this process can be extended so far as to obviate the evil of a deoxygenated outfall.

Meanwhile, smelts (not to be confounded with salmon *smolts*) have reappeared in the Thames, and have been caught in numbers since 1896 as high as Teddington. The smelt is a migratory salmonoid fish, spending most of its time in estuaries. It is hoped that where they can live and thrive, salmon and their young can pass to and fro in their annual migrations. Operations on a limited scale have been begun. In the spring of 1901, and again in 1902, some thousands of smolts, hatched and reared to their second year at Mr. W. Gilbey's fishery at Denham, have been liberated in the Thames, and the committee of enthusiasts, with Mr. W. H. Grenfell, M.P., at their head, who have undertaken administration of the limited funds at their disposal, await developments with mingled hope and boding. It is to be feared that, until

operations can be conducted on a larger scale, no definite result can be obtained.

The question suggests itself, why should salmon reared in the Thames return to it from the sea, instead of seeking another river? Some fishermen maintain that salmon always keep to the river in which they were hatched, and the probability is that most of them do so. But instances, too numerous to detail here, have occurred of individual fish, marked in one river, having been retaken in another. It has to be considered, also, that the average size of salmon varies considerably in different rivers. If we take the Solway district as an example, we find the Eden at its eastern extremity, where fish of 20 lb. are common, and those of 30 lb. and 40 lb. not unusual, while instances have occurred of salmon weighing as much as 50 lb. At the western extremity of the Solway is the Cree, wherein a fish of 20 lb. is regarded as a prodigy. What becomes of Cree-bred fish after they attain a weight, say, of 15 lb? It is not probable that they are a distinct race from the Eden fish; it is more likely that when they reach that size they desert the Cree and fall in with the other large fish which make for the Eden. The problem must wait for solution till the systematic process of marking kelts has been carried further and till our knowledge of the movements of salmon in the sea is less rudimentary.

It was in the year 1877 that attention was first drawn to what was considered a novel epizootic disease which attacked salmon in the Esk and Nith, and destroyed great numbers of them. Since that time it has appeared at uncertain intervals in nearly all our salmon rivers. The first outward indication thereof is in the shape of whitish patches on those parts of the skin which are not protected with scales, such as the head, the adipose fin, and the bases of other fins. These patches spread, become confluent, and form deep ulcers. The fish becomes quite weak and stupid, covered with whitish ulcers on the head and body,

Salmon
disease.

which spread rapidly until large areas of the skin are affected. They move into shallow water in such a helpless state that it is easy to take them out. In 1882 the late Professor Huxley contributed a paper to the *Quarterly Journal of the Microscopical Society*, which contained practically all that is known of the nature of the disease at the present day. He satisfied himself and others that it was caused by the ravages of a minute fungus, known as *Saprolegnia ferax*, the same which may often be seen on the bodies of dead flies adhering to the window-panes in autumn, and closely akin to *Peronospora*, which causes the potato blight. Probably the spores can only obtain a footing where the fish has received some external injury, when they will fix themselves and multiply rapidly; just as bacilli invade the flesh of an apple and form brown patches where the corky integument of the fruit has been broken or bruised. It is highly improbable that salmon were free from this affection previous to 1877, though it had escaped particular attention until that year. No remedy or palliative has been discovered for it. River conservators generally direct their watchers to remove the dead and dying fish from the water and bury them; but probably this would only be of advantage if the bodies were burned, otherwise it is easy to imagine many ways in which the spores of the fungus will find their way back into the river. Like all low vegetable organisms, the *Saprolegnia* manifests abnormal activity and speed of reproduction at irregular periods; and when these recur, salmon are sure to suffer. Only let no fishery owner listen to the groundless doctrine so often advanced by local wiseacres, to the effect that the disease is the result of an over-stock of salmon. In seasons when *Saprolegnia* is abundant, owing to meteorological or other conditions of which we can render no account, a percentage of salmon in the river will be attacked. Where there is a large stock of salmon, the number of diseased fish will attract much attention, and people will leap to the conclusion that the large

stock has brought about the disease. Ten per cent. of diseased fish upon a stock of ten thousand salmon will amount to one thousand—a shocking display of mortality ; but ten per cent. upon five hundred salmon will result only in fifty diseased fish, which a single flood may carry away to sea without attracting any notice at all. I have seen salmon as badly diseased in rivers where they were exceedingly scarce as in rivers where there was a heavy stock ; and, on the other hand, I have seen shallow Loch More, at the head of the Thurso, crowded with salmon throughout a hot summer, yet the salmon disease has never been reported from the Thurso at all.*

Although all salmon spawn in the autumn and winter months, covering a period from the middle of October at earliest to the end of January at latest, there is a ^{Early and} ~~Late~~ ^{Salmon} singular and hitherto inexplicable variation in the ^{rivers.} time of year at which they begin to ascend different rivers. Into some rivers salmon enter in greater or less numbers in every month in the year, nor is this dependent upon the size of the river, because it is the case both in the mighty Tay and the puny Thurso. Into some rivers salmon begin to run early in spring, while in others fresh-run fish are never found till summer or even autumn ; neither does this seem to be connected with the volume of the stream, as is shown in the case of the Bann and the Bush, rivers of Ulster, debouching at a distance of about ten miles from each other. The Bann is a noble river, flowing out of the Lough Neagh, the largest sheet of fresh water in the United Kingdom, and here, if anywhere, one might expect early salmon to run. Yet not a fresh fish may be looked for in the Bann before the month of May ; whereas in the Bush, an insignificant ditch compared with the other, flowing out of no great reservoir, but draining the peat-mosses of Antrim, salmon put in an appearance in February, and are caught in great abundance in March and April.

* See Appendix, p. 305.

Some people have assigned temperature as the regulating cause, alleging that salmon ascend those rivers which are warmer than others in the early cold months ; but here again facts are against theory, inasmuch as some of the very earliest salmon rivers in Scotland—the Naver, the Thurso, the Brora, etc.—derive their volume from melted snow, and shrink to the scale of brooks when the snow is gone. I have seen large numbers of salmon ascending the Helmsdale in February when the water temperature was only 34° Fahrenheit. On Friday, February 23rd, 1900, the Helmsdale had been thickly frozen over for many days ; the ice, as well as the whole strath and surrounding hills, being deeply covered with snow. Daily the deer came cowering down to the lodge, seeking, poor things, for some stray wisp of straw, so hardly were they pressed for food. The cold was intense. That night there came a change. Next day the water came down in flood, the ice began to break up, great bergs and fields of it went crashing down the torrent and away out to sea. The same went on all Sunday, but on Monday morning the river was clear of ice, though still very high from melting snow. I went a-fishing, much doubting whether any salmon could have had the hardihood to face such a state of things. Before night I had killed eleven spring fish, fresh from the sea, as could be seen by the sea-lice, an ugly parasite which drops off the fish soon after it enters fresh water. After that experience, I feel convinced that, although cold water may attract salmon, it is very far from deterring them from running.

CHAPTER XIII

THE ECONOMIC AND SPORTING VALUE OF SALMON

Economic Value of Salmon—Salmon-Angling—Weight of Salmon.

THE excellence of salmon as food, and the enormous productiveness of the fish in those rivers where they have received some measure of protection and encouragement, have rendered salmon-fisheries the object of constant attention on the part of the Legislature from the earliest times whereof there is any record. There can be no doubt that they form an exceedingly valuable part of the natural wealth. Taking Scotland alone, the rateable value of the salmon-fisheries in those districts where Fishery Boards have been formed was assessed in the year 1898 at £107,271. The weight of salmon carried to market by Scottish railways and steamships amounted to 4,230 tons in 1895, and to 2,093 tons in 1898. The number of boxes of Scottish salmon delivered at Billingsgate alone in 1895 was 25,364, and in 1899 it was 15,411. The average price in each month of the open season of 1899 was as follows :—

	<i>s.</i>	<i>d.</i>	
February	2	5½	per lb.
March	2	9	"
April	2	7	"
May	2	0¾	"
June	1	6	"
July	1	2½	"
August	1	5	"
September	2	3¾	"

But in addition to the market value of this excellent fish there must be reckoned its value for sport. Of all the prizes for which anglers contend none approaches the ^{Salmon-}_{angling.} salmon in nobility. It is the dream of every lad who handles a rod that some day he may land a salmon, and it is a dream of that rare class whereof the realisation fulfils anticipation. Moreover, in a material, as truly as in a metaphorical, sense, it is a golden dream ; because, whereas industrial pollution and excessive netting have greatly reduced the extent and contents of our salmon rivers, the sport has risen very rapidly in favour in recent years, and there are probably fifty would-be salmon-fishers now for every one that plied the craft fifty years ago. Rents, in consequence, have gone up in proportion to the demand for fishing water, and it is probably no over-estimate which places the average cost of salmon landed with the rod at from £5 to £10 apiece, probably nearer the latter than the former figure. Of course, with luck, an angler may have good sport at a far lower price than this ; but let him fairly reckon the good and ill luck together, and it will be found that his fish have cost somewhere between the figures quoted, either to himself or to his host. Extreme instances might be recalled where the cost has been far greater. It is not many years since a gentleman rented the Floors waters on the Tweed for £2,000 for a single season, which happened to be a bad one. He and his friends between them took thirteen fish—upwards of £153 for every salmon, without reckoning other expenses besides rent. My own recent experience is in point. Having during the last three years rented a fishing at £170 a year, I have landed in that time forty-four salmon, which pans out at £11 10s. a fish in rent alone ! However, it is not only in number and weight of fish that the angler reckons value received. He is a poor philosopher who cannot perceive more than half of every pleasure in its anticipation ; therefore he who goes forth expecting to catch ten salmon and catches none, really experiences as much enjoyment

as if he had caught five, and this takes no account of the benefit he derives from hours of healthy exercise in the open air.

The literature of salmon-fishing is so profuse, much of it such excellent reading, that it would be futile to attempt more than a recapitulation of the principal methods employed and the requisite conditions of weather and water.

First, as to the season. Spring is the time when salmon-fishing is at its prime. The fish are then in lustiest condition and most brilliant in appearance. Their ovaries have not begun to drain the fulness of the muscular system; every ounce of energy can be applied by the salmon to a fight for life and liberty; and, as a rule, salmon come more readily to the lure in the early months than at any other season of the year. The condition of water which enables the angler to pronounce a river in "good order" is when it is full, but not flooded. The most artistic method of angling for salmon is with the artificial fly; it is also the favourite with anglers, and reckoned the most sportsmanlike. But it is to be noted that it is only by courtesy that the arrangement of fur, feather, silk, and tinsel presented to the fish can be called a "fly." Salmon do not feed on flies;* moreover, as has been explained above, they do not feed at all, in the sense of taking nourishment, while in fresh water; although the predaceous instinct, curiosity, irritation, and perhaps occasional spasms of appetite, prompt them to seize and even to swallow lifelike moving objects. The salmon-fly, indeed, is a purely arbitrary evolution of the fisherman's fancy; how slender is its resemblance to a natural fly may be realised on examining the trays in any fishing-tackle shop. These baits are classed as flies, and their exhibition is termed fly-fishing, by analogy with trout-flies and fly-fishing, wherein the intention is to simulate natural insects.

* Nevertheless, when March browns come thickly on the water in spring, salmon may occasionally be seen rising freely at them.

The variety of material, the combination of colours, and ingenuity of design displayed in salmon-flies is truly inexhaustible. Personally I am thoroughly sceptical about the superiority of one pattern over another, having repeatedly, in the course of a long experience, had excellent sport by using whatever flies happened to be in my box, and disregarding the warning of local fishermen to the effect that none but flies of a peculiar hue and shape were of any avail in their waters. I could name half a dozen different rivers in which, when I was a youth, grey, brown, and neutral tinted flies were prescribed as essential to success. At the present time in these waters, the brightest combinations of colour and tinsel are preferred, and, so far as I am concerned, it is a matter of perfect indifference whether I display an old-fashioned dun turkey or grey mallard, or mount a hook bedecked with gleaming tinsel and half the colours of the prism. William Scrope, writing sixty years ago, mentioned that brightly-hued Irish flies had recently been introduced on the Tweed, and added that the fishermen on that river attributed the scarcity of salmon, whereof they had to complain, to the terror inspired by these uncanny baits, which, they believed, drove the fish back to the sea! The fact is that favourite locally indigenous flies are nearly always dull in colour, because bright feathers and materials were not easily obtained by those who invented them a hundred years ago. There is no surer killer in *any* river than the dun turkey—a venerable creature devised Lord knows how many generations back. What does it consist of? Strands from the tail feather of the dun turkey, once to be found in almost every farm on every river, although now the breed is nearly extinct, supplanted by more fashionable strains; a black hackle from the neck of the barn-yard chanticleer; some black and red yarn from any frayed and worn carpet, and a tag of yellow wool from the good-wife's basket. When salmon-fishing became a fashionable sport, travellers and visitors adopted these local patterns, which varied

a little on every river—here, instead of a dun turkey, a grey goose supplied the feather ; there, it was the mottled scapular of a drake ; on a third river, accident having provided a preponderance of yellow wool, yellow became the indispensable colour, and so on.

Next, anglers who had experienced chagrin and loss of fish from the uncertainly-tempered hooks obtained by the riverside, took to employing town tackle-makers to dress their flies according to the local patterns. The cost of these simple confections being not more than threepence or sixpence each, no honest tradesman cared to charge more than represented one hundred per cent. profit ; so gradually they began to use more costly plumes. This was greatly to the advantage of the trade, for, strange as it may seem, anglers are so credulous a race that it takes no persuasion to convince them that there is some invincible attraction for British salmon in the feathers of Indian jungle-fowl or chattering from Borneo which is not to be found in the plumage of our native birds. Absolutely contrary as this may be to experience (it certainly is so to mine) and to common sense, so strong is the conviction thereon that fishermen are content to pay from half-a-crown to seven-and-sixpence apiece for flies ; and, withal, to carry with them a vast number of varieties. Irrational as this is, it must be confessed that it adds very much to the fascination of the sport ; and surely the sport of angling itself is irrational in its essence, for he who desires to catch fish may attain his end more speedily and surely with the net than with rod and line.

Casting the fly, as in trout-fishing, but on a grander scale, is by far the most exhilarating method of salmon-fishing, and is that which every true sportsman prefers when it is feasible ; but in very large rivers the labour becomes too monotonous for pleasure, and what is called in Scotland “ harling ” is resorted to. Two or three rods are placed in the stern of the boat, thirty yards or so of line are let off each, and the boat is allowed

to drop down-stream gently in zigzag fashion, which plays the flies over all the likely places. A bight is pulled in the line just above the reel and laid on the thwart; a pebble keeps it in its place, which bounces off with a fine clatter when a fish seizes the fly, perhaps rousing the angler from a snooze, to which this indolent kind of fishing renders him very prone. Then there ensues a fine scuffle, the sportsman seizing the rod in play to do battle with the salmon, the boatman reeling in the free lines at express speed to avoid a foul. There is only one river in Great Britain where harling the fly is still practised, the Tay to wit; but even there it has fallen out of favour, and casting has become more the custom of late years. Whether harling be practised in the Shannon, I cannot tell, never having angled in that noble stream; but in the Namsen, the Alten, and some other great rivers of Norway it is the rule.

Besides the fly, there be other lures reckoned legitimate in angling for salmon—namely, the spinning bait, natural or artificial; the boiled prawn, and the worm, each of which often proves successful at times when the others fail. The element of uncertainty, which is inseparable from every mode of taking fish depending upon their voluntary act, is greater in salmon-fishing than in any other, for the simple reason that salmon are never “on the feed” in fresh water. Everything depends upon the caprice, not the appetite, of the fish. You may fish over a pool with twenty salmon lying in it, yet not one may take the fly or other bait. On the other hand, you may hook and kill the only salmon in a pool at the first trial; and again, you may fish over him twenty times, and never move him till the twenty-first, when you bring him to the gaff. The first salmon I ever killed in Norway afforded an instructive illustration of this glorious uncertainty. It was on the Rauma, that splendid torrent which tears its way through the stupendous Romsdal. It was five o’clock on a Saturday evening—the last day of June—when I arrived at the lodge, and found that

two rods had been at work morning and afternoon without landing a fish, the water being still too heavy. My hostess asked whether I would have some tea, or fish the pool next the lodge, which had been well flogged that day. Now in Norway Sunday begins at 6 p.m. on our Saturday, so there was not time for both. Without a moment's hesitation I declared for fishing. It was a quarter-past five by the time I got afloat; at half-past five I struck a fish, and landed him just in time to save breaking the Sabbath—21 lb.

Of course it is probable that this fish had newly arrived in the pool, and took the fly at the first offer; but here follows an example where there was no question of fish running, for the water had run very low. It was in the Luce, a small river in the west of Scotland, and on the last day of the season. The sun was bright; there were but two or three places where there was a faint chance. I had tried them all but the last, and any lingering idea I had of success there was dissipated as I approached the pool by the flash of another angler's rod in the sunlight at the very place. I sat down and prepared to take down my tackle; but I was young in those days, and hope dies hard on the bright side of thirty. I saw my rival finish the pool and walk away.

"Come!" methought, "it is the last chance of the season. It is sometimes the rank outsider that pulls off the big event."

Well, the event weighed just 22 lb. avoirdupois, and I pulled it off—or rather, pulled it in—the handsomest salmon I ever saw so late in the season, except in the Tweed.

Probably the most notable performance by a party of salmon-anglers, at least in regard to the number of fish killed, was that of three gentlemen—Mr. George Probyn, Mr. A. M. Naylor, and Mr. H. L. Hansard—in the Grimersta River, in

Harris. This little river flows through a chain of lakes, in which most of the angling is carried on by means of boats. The great run of fish—salmon, grilse, and sea-trout—is due towards the end of July annually; but in that year (it was somewhere in the 'eighties) so great was the drought that, although many thousands of fish thronged the fjord into which the river flows, none of them could ascend into the lochs. A party of five anglers waited wistfully for rain to carry the fish up, and at last two of the party left the island in despair. The remaining three set their wits to work and established a noteworthy illustration of what may be effected by judicious use of natural resources and water storage. As the lesson is of first-rate importance to managers of fisheries, I prefer to quote Mr. Hansard's own description of the operation as communicated by him to the *Field* newspaper (November 8th, 1902). It should be mentioned, in order to give a right impression of the pluck and enterprise of these three gentlemen, that their lease of the fishings was to end on September 1st.

"From the formation of the lochs it struck us that an artificial spate might be made by cutting away the river bed, and letting down water from one of the upper lakes. We explored all the likely places, and at last hit upon the lower end of Loch Langabhat as being a suitable place for the work. This was easier to do than it sounds, as some years before a hatchway had been made there, with a grating to keep the fish from running into Loch Langabhat. Unfortunately, this useful work had gone to ruin, but it was easy to grub up the bed of the stream where the grating had been, and so let down nearly two feet of the big lake, which is ten miles long by half to one mile across. At the bottom of our first loch, *i.e.*, the one nearest the sea, we then made a dam across the river head, some six feet high, as solidly as we could with rocks and turves. All this was rather against the opinion of the gillies, who declared that no salmon would run up except in water

fresh [from the] sky. As the water gradually worked down through the chain of lochs, it filled up this lower lake to the top of the dam. But this took a long time—nearly a week. When at last this was accomplished we were ready to cut the dam, and, as it was some one and a half miles from the sea, we reckoned (as it proved correctly) that it would take an hour for the water to reach the sea from the lake. On August 22nd the high tide was about 4.30, so the dam was cut after lunch, and, as a fact, did not take much cutting, as in a few more hours it must have given way.

“As I have described, at the mouth of the river was the large sea basin, at high tide crammed with fish pressing up as near as they could to where the little trickle of fresh water was still running. As the fresh water from the loch came rushing down the excitement began. First a small shoal of salmon tried the passage, then more came rushing in. So madly did they swarm in that they pressed each other to the sides, and many ran right ashore or scrambled up in water not deep enough to cover them. Had we wished, nothing would have been easier than to have scooped them out in landing-nets by the score.

“We sat watching this wonderful sight till it grew dusk, and had long given up counting or trying to estimate the numbers of fish running in. They must, without exaggeration, have run in by thousands in the forty-eight hours that our spate lasted. The next morning, I well remember, was clear and bright, and, walking up the river, the pools seemed literally paved with fish, even in all sorts of unlikely and unaccustomed places.”

The result was a munificent reward for the labour expended. The fish, instead of being spread throughout the whole chain of lakes, were crowded into the lowest lake, which is little more than a mile long. The bag for six days was as follows, all the fish being fairly taken with the fly:—

		Salmon.	lb.	Sea-trout.	lb.
Aug. 27.—	Naylor . . .	15	94	6	8
„	Probyn . . .	36	210	4	2
„	Hansard . . .	8	39	7	4
Aug. 28.—	Naylor . . .	54	314	12	6
„	Probyn . . .	15	80	3	3
„	Hansard . . .	9	57	3	2
Aug. 29.—	Naylor . . .	15	89	3	2
„	Probyn . . .	1	6	—	—
„	Hansard . . .	27	184	5	4
Aug. 30.—	Naylor . . .	2	16	3	2
„	Probyn . . .	18	113	4	3
„	Hansard . . .	5	29	—	—
Aug. 31.—	Naylor . . .	45	269	5	4
„	Probyn . . .	7	37	3	2
„	Hansard . . .	11	63	4	5
Sept. 1.—	Naylor . . .	12	74	2	1
„	Probyn . . .	7	44	—	—
„	Hansard . . .	46	308	7	4

TOTAL FOR THE WEEK.

	Salmon.	lb.	Sea-trout.	lb.
Naylor	143	856	31	23
Probyn	84	490	14	10
Hansard	106	680	26	19
	<hr/>	<hr/>	<hr/>	<hr/>
	333	2026	71	52

One of the main sources of excitement in salmon-fishing is the average size of the fish, and the great weight to which they sometimes attain. Hitherto, in this country, ^{Weight of} _{Salmon.} the heaviest fish on authentic record has been taken by the net in the Tay, weighing 70 lb.; but a fish of upwards of 60 lb. was taken on the spinning bait from the Stanley water on the Tay during the same season (1870); and every angler who puts his luck to the test in that magnificent river is entitled to expect to break that record.

A salmon of upwards of 70 lb. is credited to the rod of Sir Richard Musgrave from a river in British Columbia, and

Mr. Wilfred Kennedy landed one of 68 lb. in the Aora, a Norwegian river, in August, 1894. The following particulars of heavy fish taken in the United Kingdom were noted by Frank Buckland :—

Date.	River.	Weight.	Length.	Girth.	Mode of Capture.
Oct. 23, 1869	Shannon	44 lb.	4 ft. 2½ in.	2 ft. 4 in.	Rod.
June, 1870 .	Tay	70 lb.	4 ft. 5 in.	2 ft. 7½ in.	Net.
Aug. 1879 .	Tay	65 lb.	4 ft. 5¾ in.	2 ft. 1¾ in.	Net.
	Tay	53 lb.	4 ft.	Not recorded	Net.
	Tay	49¾ lb.	4 ft.	Not recorded	Net.
April 2, 1880 .	Avon (Hants)	53 lb.	4 ft. 4½ in.	2½ ft.	Net.

To which I may add the following from a letter received from Mr. P. D. Malloch, of Perth, while these lines were being written (July, 1902): "We have got two salmon (in the nets) over 60 lb. last week, and one yesterday 50 lb., only 4 ft. 1 in. long—a great beauty." On June 16th, 1902, a salmon weighing 50 lb. was taken by Mr. Dugdale's keeper with fly on the river Ewe, Rosshire. There may be added here the following authentic instances of large salmon captured *by rod and line* in Ireland: one of 58 lb., in 1872, on the Shannon; one of 57 lb., taken on the Suir in 1874 by Michael Maher, a professional fisher; and one of 54 lb., taken on the Shannon, February 14th, 1903, by Mr. F. Milburn.

The salmon of British waters is naturally abundant in those of the Atlantic coast of North America; but on the Pacific coast its place is taken by the quinnat, or Californian salmon (*Oncorhynchus quinnat*), which it has seemed expedient to systematic ichthyologists to classify in a distinct genus, because it has more than fourteen rays in the anal fin. Attempts have been made to introduce this species into European waters; but anglers have good cause to pray that the success which is reported to have attended them may be fictitious, because these fish are said never to rise at the fly.

CHAPTER XIV

RECENT LIGHT UPON SALMON PROBLEMS

THE great importance of the salmon, both from a commercial and a sporting point of view, must serve as my excuse for adding a chapter of comment upon the latest results of systematic observation, and the conclusions to which they tend. It is of value from time to time to focus the information which we have upon obscure topics.

Truth it is, that upon no subject of human interest, theology always excepted, has controversy raged more fiercely or dogma been more fearlessly wielded than upon the habits and nature of this noble fish. In neither of these fields can be traced any sign of slackening enquiry ; but whereas in theology the professors seem as far asunder as at any period of history, the leaders of research upon the salmon problem have lately elicited certain facts which contain material for agreement upon some of the chief points in dispute, and promise the dispersion of much of the mystery which has so long obscured the life-history of one of our most important food-fishes.

Admitted that some degree of obscurity is inseparable from both theology and ichthyology, it is not inconsistent with profound respect for the professors of both sciences to observe that a great deal of it has been created by themselves. Christianity remained a fairly simple creed until, as an organisation, it obtained clear ascendancy over pagan philosophy, and ecclesiastics, relieved from immediate concern for their

own skins, began to contrive conundrums for their disciples, and to launch problems of the *chimæra-bombinans-in-vacuo* type. So in the matter of salmon, it sometimes has been men of science and system who boggled over the sound conclusions arrived at in the course of their vocation by plain, practical fishermen. Let no man underrate the value of study in museum and laboratory, but experience has shown that it is apt to grow top-heavy, unless it is supported by the humbler labours of the field naturalist. Thus we find that excellent ichthyologist William Yarrell solemnly devoting a chapter of his *British Fishes* (1836) to the parr, or samlet, which he followed Willughby, Ray, and Pennant in classifying as a distinct adult species under the title of *Salmo salmulus*. Yet, within a very moderate distance of his own newspaper shop in Westminster, he enjoyed opportunities of studying the creature which are denied to the London naturalist of our day.

“The skegger of the Thames,” quoth he, “is the parr, or samlet. Laleham, between Staines and Chertsey, where the water is shallow, formerly afforded the greatest quantity; forty and even fifty dozen have been taken in one day by a skilful fly-fisher; but the numerous gas and other manufactories on the bank of the river are considered so greatly to have affected the quality of the water, that a salmon or a skegger in the Thames is now but rarely seen.”

One need scarcely doubt that the “skilful fly-fisher” thus modestly referred to was Yarrell himself, seeing that during his father’s life William is known to have spent at least as much of his time angling on the river as selling newspapers across the counter.

Sir William Jardine, another ichthyologist of high attainment, was equally confident in controversy. He studied parr in the Tweed, and, after dismissing as groundless the belief entertained by some ichthyologists and by most practical fishermen that parr were the young of salmon, summed up as follows in 1835:—

"The greatest uncertainty has latterly resolved itself into whether the parr was distinct, or a variety or young of the common trout *S. fario*. With the migratory salmon it has no connection whatever. . . . I have no hesitation whatever in considering the parr not only distinct, but one of the best and most constantly marked species we have, and that it ought to remain in our systems as the *Salmo salmulus* of Ray."

Of course, all this haziness has been cleared away by the labours of pisciculturists; parr have been reared by the million from the ova of salmon, but the curious part of the matter is that no doubt seems to have arisen about the identity of parr with young salmon until men of science began to mull over them. About smolts, at all events, our early legislators spoke with no uncertain voice, and although a smolt preserved in spirits in a museum may seem a very different fish from a parr in the next bottle, it is difficult to see how any *practical* fisherman could entertain any doubt that they were the same creatures in different stages, seeing that the little fellows may be taken any day in April or May in every stage of transition, from the spotted and barred river dress to the silvery jacket they assume on moving seaward. And so in the thirteenth century Alexander III. of Scotland enacted that "smolts should not be taken or destroyed by nettes or other ingynes at mylne dams fra the middes of Aprill to the nativite of Saint John the Baptist (June 24th)," which covers the whole period when smolts can be found in any river. Before becoming smolts, *i.e.*, before they assume in April the migratory livery of silver, they are spotted parr, and they are all in the sea before Midsummer Day.

No better example could be found of the auxiliary value to the scientific student of the mere sportsman, provided he has brains as well as eyes in his head, than that afforded by William Scrope, the inimitable author of *Days and Nights of Salmon-Fishing* (1838). Many years before Shaw's experiments had proved conclusively that parr were immature salmon,

many years before Yarrell and Jardine had pronounced them authoritatively to be a distinct species, Scrope had urged upon the Legislature the futility of preserving smolts unless parr received protection also. His view, and the unanswerable grounds whereon it rested, were communicated to Mr. Kennedy, who had introduced a Salmon-Fishery Bill to the House of Commons early in 1825.

Well, the parr and smolt dispute was decided long ago, and there is no need to stir it afresh. The only justification for recalling it at this time of day is by way of warning against accepting either *a priori* theories or mere circumstantial evidence upon any phase of the life and habits of the salmon, and as showing the necessity of checking the results of scientific research by the observation of practical fishermen, and *vice versa*.

I must now revert to a point whereon the riverside men have been proved by men of science to be in serious error. It is a belief commonly entertained among anglers and fishermen that kelts—*i.e.*, salmon descending to the sea in an emaciated condition after spawning—are ravenous creatures, devouring quantities of the young of their own species. This has given rise to a cry for repeal of the clauses in the Salmon Acts which make it illegal to kill kelts. At one time, and that not so very long ago, men of science were on the side of the calumniators of kelts. Writing as recently as 1886, Professor Seeley expressed himself as follows:—"After spawning, salmon develop cannibal propensities, and the old feeble kelts which remain in the river grow voracious, and consume immense quantities of salmon fry, before they recover strength enough to go down to the sea."*

It might be supposed that an ichthyologist of Professor Seeley's standing and experience would not have made such a serious charge against kelt salmon without ample evidence to support it. But there is none, or next to none, and a great deal of evidence against it. In the first place, nobody ever has

* *The Fresh-water Fishes of Europe*, p. 269.

seen kelts in pursuit of salmon fry ; and they could not pursue them without being seen, inasmuch as fry and parr remain constantly in the shallows, and kelts must be looked for in the deep, slow parts of a river. In the second place, in 1880, six years before Professor Seeley's book was published, Professor Miescher Ruesch had contributed to the literature of the Berlin Fisheries Exhibition a report upon his prolonged experiments and observation upon the salmon of the Rhine.

He stated that in a series of nearly 2,000 salmon taken and examined in the upper waters of that river, he found evidence of feeding in the stomachs of *two only*, both of them male kelts. In the stomach of one of these were the scales of a cyprinoid fish (dace, roach, or minnow), and in that of the other was an acid secretion showing that digestion had been going on. He described the stomachs and gullets of salmon taken at Basel, 500 miles up the Rhine, as being contracted, wrinkled, and folded, in strong contrast with the distended stomachs and gullets of salmon taken at sea, whence he drew the conclusion that "the Rhine salmon from its ascent from the sea to its spawning, *and also after this*, as a rule takes no nourishment." Now, that Professor Seeley, who describes himself on his title-page as foreign correspondent of certain scientific bodies in Europe and America, should have ignored or failed to acquaint himself with the result of Professor Miescher Ruesch's observations, is a striking illustration of the loose way in which salmon problems have been handled in the past. Professor Seeley, disregarding, or ignorant of, the only direct evidence upon the feeding of kelt salmon, has repeated the mischievous and baseless charge of cannibalism made against them by people who cannot be made to understand the nature of scientific evidence. The whole hypothesis rests upon the esurient, emaciated aspect of the kelt, and his presence in the same river with thousands of edible little members of his own species—surely not firm

enough ground upon which to base the theory that salmon devour salmon. It is quite true that certain fish, such as pike, trout, and others very low in the scale of vertebrate animals, are at times pressed so hard by hunger as to transgress the law which the fiercest mammals respect, and the stronger individuals make prey of the weaker of their own kind ; but it is tolerably certain that, so soon as a kelt feels the seasonal return of appetite, he makes off to the sea to satisfy it. The only circumstance which might make him turn cannibal would arise in the event of his being imprisoned in the river by drought, in which case no doubt the kelt would not be particular about his diet ; he would stay his stomach with whatever edible objects he could find.

Nobody, I suppose, has ever accused fresh-run salmon of cannibal propensities, and anglers often receive the impression that kelts are far more ravenous than fish which have just entered the river from the sea. The fact is that, in the spring months, when kelts are descending to the sea, and clean fish are beginning to run from it, probably more kelts will be landed by fly or spinning bait than clean fish ; the reason being, not that the kelts are more hungry, but that they are far more numerous than the clean fish.

My own belief, founded on prolonged observation, is that the clean-run fish takes the bait far more readily than the spent fish, not because he is the hungrier of the two, but because his vitality is higher and his predaceous instinct more alert.

There are good grounds for believing that, from the time the salmon leaves the sea until after the operation of spawning, it takes no nourishment. Instances may occur of salmon in fresh water swallowing edible objects, but the fact remains that such objects have never been detected in their stomachs, nor the *débris* of them in their intestines. That salmon in rivers and lakes seize moving objects, which may or may not be edible, such as minnows, worms, and artificial flies, has been cited as proof that they feed in fresh water, and the uniform emptiness

of their stomachs has been accounted for by a hypothetical power of ejecting the contents when they are netted or hooked. But to found on such a hypothesis would be childish, seeing that the ejecting power cannot be limited to the period when the fish are in fresh water, and that the stomachs of salmon taken at sea are often found gorged with food. I have given below (page 238) some evidence tending to show that, should the period between entering the river and the maturation of the ovaries be so prolonged as to cause a return of appetite consequent upon the necessity for nutriment, the fish will revisit the sea before spawning.

For some time after spawning the salmon remains in the river as a "kelt," or spent fish. The investigations conducted in the Rhine by Dr. Hock and the late Professor Miescher Ruesch led them to the conclusion that during this period also the digestive tract of the salmon remains functionless, or, at most, capable of very feeble action. This has since been confirmed in the course of investigations upon British salmon conducted in the Research Laboratory of the Royal College of Physicians of Edinburgh in co-operation with the Fishery Board for Scotland. The observations of these gentlemen all tend to establish the fact that, although traces of food may occasionally be detected in the stomachs of spent fish, especially after they have reached the tidal water, the true feeding-ground of the salmon is the sea, and that it performs a physiological fast as long as it remains in fresh water.

It is to be noted that the conclusions of the Edinburgh Committee, as reported upon in 1898,* have been checked by an independent biologist, Dr. Kingston Barton, who detected a very serious error in one of their processes. The Committee were led to believe that, so soon as the salmon entered fresh water, its digestive tract underwent a morbid change, described as "desquamative catarrh," rendering the organ functionless

* *Report upon Investigations on the Life-History of the Salmon*, H.M. Stationery Office, 1898.

and incapable of digesting food. Dr. Barton, while agreeing that the stomach ceased to discharge its normal functions, conclusively proved that what the Committee had interpreted as a morbid affection during life, was really a stage of *post mortem* decomposition.* It is satisfactory to note that the Committee have heartily accepted his correction of their mistake, and that a paper by Dr. Barton has been printed as Appendix III. to the Twentieth Annual Report of the Scottish Fishery Board, showing his concurrence with the Committee in their interpretation of the symptoms as those of prolonged fasting.

In another place Dr. Barton, after examining nearly two hundred salmon in 1899, affirmed his belief that "the salmon who reaches our rivers has begun a long physiological fast," and agreed with Dr. Noel Paton in finding "how feeble the peptogenic powers of the upper part of the digestive tract in salmon become when the fish enters the rivers."† In a later paper the same observer has given the result of his examination of kelt salmon, both from the tidal and upper waters. In every case the stomach was quite empty and contracted, "showing no very recent feeding, yet there was just sufficient material in the lower bowel to confirm (? strengthen) the suspicion that food had been digested. . . . It is very evident that kelts do not feed with the frequency that sportsmen would have us believe."‡ Even this cautious inference is limited by Dr. Barton's proviso in his report upon kelts from the Tweed: "If staining with osmic acid is to be taken as proof that fat cells in the lacteal system actually contain fat, then the sections from tidal kelts must be taken to mean that these fish have absorbed nourishment within recent times."

It is notoriously difficult to prove a negative; but, before acting upon Professor Seeley's authority, and proclaiming kelts to be mischievous vermin, devouring their own young, it is

* *Journal of Anatomy and Physiology*, April, 1900, pp. 298-9.

† *Ibid.*

‡ *Ibid.*, January, 1902, pp. 142-6.

incumbent upon those who hold his view to prove—first, that spent salmon are physically capable of doing the alleged mischief; and secondly, that they have been detected in the act. As to the last, there is the negative testimony of Mr. T. G. Thompson, printed in the Fifteenth Annual Report of the English Salmon-Fisheries Inspectors:—

“During the past two springs I have carefully watched kelts and smolts when congregated in very large numbers in the same pool above a weir, where they were imprisoned on account of there not being enough water to take them over the sill of the weir. The smolts were swimming peaceably about and without harm among the kelts, as if fully aware that the cannibal instincts attributed to their full-grown relations were not to be feared by them in the least.”

Probably, of all the legal enactments for the preservation of salmon, except those securing a free passage over obstructions, none has done more to palliate the results of excessive net-fishing than the protection afforded to kelts during the last forty years. It has been the chief means of saving a stock of mature fish in such rivers as have not been specially managed in the interests of angling.

Kelts, although unseasonable fish, are mature salmon; the more of these that are allowed to return to the sea, the greater the chance of some of them revisiting the rivers, increased in size. It was, therefore, not unreasonable in those who successfully advocated the protection of kelts, to predict an increase in the maximum weight of fish captured. The prediction has been amply fulfilled. It will hardly be disputed that salmon, especially spring and summer fish, were far more numerous in the Tweed sixty years ago than they are now. Except in unusually wet seasons, when a succession of floods enable fish to run past the nets in the estuary and lower reaches, the spring rod-fishing in that once famous river is now of small account; and as for summer angling, it is practically at an end. Yet there has been a notable increase in the weights

of individual fish. William Scrope, writing in 1843, said that of the many hundreds of salmon which fell to his share in the Tweed, not one pulled the scale to thirty pounds. He describes, indeed, how in 1815 Robert Kerse hooked a clean salmon of "about forty pounds" in the Makerstoun water; but that fish never came to the scale; for, although Rob landed him after having "sair work wi' him for some hours," the salmon escaped while his captor was looking for a stone to fell him with. Nowadays, thirty-pounders may be termed frequent in the Tweed; never a season passes without forty-pounders being recorded, and there can be no doubt about the accuracy of the following weights of fish killed by fly-fishing.

1873. A salmon of 53½ lb. Captor not recorded.

1886. One of 57½ lb. killed by Mr. Pryor on the Floors water.

1889. One of 55 lb. killed by Mr. Brereton on the Willowbush, Mertoun (a favourite cast of Scrope's).

1892. One of 51½ lb. killed at Birgham by Col. the Hon. W. Home.

Depend upon it, had Scrope heard of fish such as these he would have gossiped about them in his own delightful way, and he could not have failed to hear of them, had they been taken, for nowhere is rumour more fleet than by the riverside among anglers. I fail to imagine any cause for the increase of weight here manifest, except that the protection of spent fish has enabled some of them to attain a greater age, with a proportionate increase in avoirdupois. If that is so, would it not be a disastrous error to withdraw that protection, upon the *a priori* ground that kelts devour their own young?

Several points of interest in the life-history of the salmon have been elucidated, or brought near elucidation, by the researches of the German ichthyologists and the Edinburgh Committee. Among others is that of the well-known change of colour after the fish leaves the sea. Its coat, when it ascends the river, is indescribably pure and bright, the silvery tone being imparted by the deposit under the scales of an

inorganic substance known as guanin. The salmon has not been many days in the fresh water before this brilliancy becomes duller, until, after a sojourn of some weeks, the males become ruddy brown and copper-coloured, the females sooty grey and purplish. Fishermen usually regard this as the result of the oxidising properties of fresh water, and indeed it is very similar in effect to the tarnishing of silver. But this explanation fails to account for the phenomenon exhibited after spawning. Kelts rapidly use the dark tones assumed by gravid fish, and, before they reach the sea again, become as white and silvery as they were when they left it. It is probable that these changes in skin colour are independent of external agents, and arise from alterations in the circulatory system. In the higher vertebrates, the skin colour or complexion is intimately connected with the circulation ; so, in the salmon, it is probable that when the blood stream is diverted from the stomach to the growing ovaries, not only does the stomach become functionless, but the effect is immediately seen upon the skin. After the milt or ova are deposited, the blood reverts to its normal course, the stomach begins to resume its normal condition, and the skin recovers its brilliancy. That, very roughly and briefly stated, is the conclusion to which research has tended, although the reader is entitled to be spared the physiological details upon which it rests, and also the evidence for the transference of ruddy pigment in the muscle of fresh-run salmon to the skin in the males and to the ovaries in the females.

Then arises the question—what is a “well-mended kelt,” so well known to anglers ; a kelt, that is, which has recovered not only its lustre, but, apparently, regained some muscle ? The process of “mending” has been well described by Professor Miescher Ruesch :—

How altogether different is the picture if we have the opportunity to see the creature ten days, or, better, two weeks after spawning. The skin is again bluish, shining and clear ; the ulcers cicatrised and healing, the

flesh transparent and free of oil-granules. The heart-fibres also participate in the regenerative change ; in the intestine is no trace of food. On the other hand, the ovary contains sometimes more, sometimes fewer, eggs, which are imbedded in a serious or somewhat purulent effusion of the follicular membrane, and are evidently shrinking and being absorbed. *They are thus a kind of nourishment, a provision (zehrgeld) for the return journey.* But I ascribe the chief importance to the pale, shrunken, and folded follicular membrane. The collateral vessels of the ovary are closed through vascular contraction. The salmon is like a patient who has had a leg amputated after the application of an Esmarch's bandage. Its blood courses in a narrow circulation, and therefore with higher pressure, and supplies a less amount of oxygen-requiring matter than formerly. The circulation is again sufficient for its task, and the trunk-muscles become normal. . . . The little nutrient matter coming from the ovary greatly helps the restoration of tone to the muscle.

In March, 1901, Dr. Kingston Barton, having obtained leave from the Conservators of the Hampshire Avon, killed a bright, well-mended grilse kelt weighing about 5 lb. The new ovaries were formed already, and measured three inches long ; the stomach was empty, contracted, and wrinkled, but within the abdominal cavity there were eight full-sized ova, which had remained unshed when the old ovaries had been extruded. On the other hand, all the milt of male fish is invariably shed at spawning time ; none remains to be re-absorbed as a restorative for the exhausted fish. The scarcity of male kelts as compared with females may be connected with this difference in the provision for recruiting the energies of the two sexes. Either the percentage of males perishing after spawning is larger than that among females, or the males, feeling earlier the want of nourishment, hasten soonest to the sea.

But is it certain that male kelts are less numerous than females ? Every angler and fisherman, relying upon external badges of sex, will tell you so ; but they will pronounce with equal confidence upon the sex of fresh-run spring fish, and *that* it is impossible to decide without opening the ovary. This was tested some years ago on the Tweed by Mr. Walter

Archer. On several days in succession he asked the net-fishermen to lay out their catch according to sex. They did so without hesitation. Mr. Archer then obtained leave to make a small incision in each fish to expose the ovary, and proved that the fishermen were just as often wrong as right. It is probable, therefore, that all but the largest male kelts speedily get rid of the cartilaginous growth on maxillary and mandible, which distinguishes the male at the time of spawning. This suggestion is considerably strengthened by some of the entries in the tables of marked fish recaptured and recorded by the Fishery Board for Scotland.*

There are a number of instances such as the following :—
No. 1,909 : An unspawned fish taken in the Spey on November 28th, 1896, is returned as a *female* weighing 18 lb. The sex at time of capture must have been evident beyond all doubt. The same fish, recaptured on March 27th, 1897, is returned as a *male* kelt weighing 12¼ lb. Again, No. 2,032 is taken in the Spey on December 23rd, 1896, marked and returned as a *male* clean fish weighing 7½ lb. Recaptured on February 16th, 1897, it is returned as a *female* clean fish of the same weight. In short, out of 190 fish specified in the return to have been recaptured, no less than twenty-three, or about 12 per cent., are shown as having changed sexes in the interval. This surely ought to make one slow to found upon external indications of sex.

Reference has been made above to fresh light which has been thrown upon the disputed question of the to-and-fro migration of salmon between the sea and fresh water, other than the single ascent to and descent from the spawning beds. Obviously this point is of much importance to the preservation of rivers and to any legislation which may be devised to prevent undue depletion of stock ; because thereon depends the amount of loss to which the stock is exposed during a single season at the hands of net-fishers. Forty years ago the

* *Report*, Part II., 1902, pp. 63-72.

late Mr. Dunbar, who made good use of his opportunities as tenant of the whole net and rod fishings of the river Thurso to elucidate salmon problems, claimed to have proved that some, at all events, of the fish which run into the upper reaches in winter and spring return to the sea during the summer months without depositing their spawn, presumably to reascend the river in a gravid state in autumn. If this were so, then the same fish may have to run the gauntlet of the nets, not once, as is commonly believed, but three times—namely, in their first ascent, in their descent, and in their second ascent.

This question is dealt with in the Report of the Edinburgh Committee, and dismissed with the remark that “there is absolutely no evidence that, once having fairly entered the river, they ever return to the sea in any considerable number.”* Now it happens that, since this report was published (in 1898), I have received evidence, which can hardly be misinterpreted, to the effect that considerable numbers of the early running fish do return to the sea before spawning. In January, 1900, I became joint-tenant with five others of the whole of the net and rod fishings of the Cree and its tributary the Minnick, rivers of Western Galloway debouching into Wigtown Bay. All nets were removed from the inland and tidal waters, and the rivers were reserved exclusively for angling. By the beginning of July in that year a large number of salmon and grilse had run up to the upper reaches. In one short portion of the Minnick, so small in volume and so far away in the moors that it is seldom fished, one of our watchers counted 120 fish, many of them salmon of 7 lb. to 12 lb., which had run up in April and May, and had become dark and discoloured. Early in July there was a heavy spate; when it subsided, the watcher missed his fish. They had not run further up, because above that point the river consists of a mere confluence of burns and becks, where the presence of fish would have been easily detected; so he set down their disappearance to poachers.

* *Life-History of the Salmon*, p. 76.

There was much rain all July, and a heavy run of grilse. I was absent that month in Norway, and on my return was informed that a number of dark fish had been taken in the stake-nets in the bay. The fishermen spoke of it as a regular occurrence at that season. They considered these fish as having returned to the sea from the upper waters, and they received a lower price for them than for fresh-run salmon.

I took immediate steps to secure some of these discoloured fish for examination. Unluckily, I was too late, and only succeeded in obtaining one—a male—which was sent to the Edinburgh Research Laboratory on August 25th, where analysis showed that the skin had begun to turn red and the muscle was pale; there were parasites in the gills and no sea-lice on the body—indications that the fish had passed some time in the river.

The following year (1901) was an abnormally dry summer, and there was no flood from the first week in June until the very end of August; nevertheless, early in August, I obtained two or three of these fish, and forwarded them to the laboratory. I have not yet received a report upon their analysis.

Assuming, as I have no hesitation in doing after hearing the evidence of the net-fishers, that the appearance of these fish in salt water is a regular phenomenon after July floods, it is perfectly clear that their descent from fresh water must be a voluntary migration. A similar seaward movement has been noted as regularly taking place in the Helmsdale; but that is a rapid Highland river, entering the sea with scarcely any tidal estuary, and the theory might be advanced that salmon, weakened by a long fast, might be washed down out of the upper reaches by heavy summer floods. But in the Cree no such explanation will hold good. In the first place, although the upper reaches of that river are rapid and Highland in character, between them and the sea intervenes the Loch of Cree, fully three miles in length, and above the nets where these discoloured fish were

taken are eight or nine miles of winding, tidal, muddy estuary. The migration, therefore, must have been deliberate, voluntary.

As for the cause of the movement, it does not seem very obscure. The salmon, a native of fresh water, has acquired the habit of resorting to the sea for food. It is imperative that it should leave the sea for purposes of reproduction (salt water having been proved to be fatal to the vitality of salmon ova), hence it has generally been assumed that the *nisus generativus* is the only impulse to which the inland migration is due. But the Research Committee have proved abundantly that, while the act of spawning is restricted to a period varying in different latitudes between the end of October and the end of January, salmon leave the sea during every month in the year, and with their ovaries and testes in every stage of development. The cause which makes the fish leave the sea, independently of the *nisus generativus*, is that "when, on the rich marine feeding-grounds, as great a store of nourishment as the body can carry has been accumulated, the fish returns to its native element."* When this return takes place in the winter or spring months, it may well happen that the accumulated nourishment, which is the source of energy in the fish, becomes expended in the long interval which must elapse before the spawning season, and resort is had to the feeding-grounds for a fresh supply of energy to enable the salmon to undertake the exhausting functions of reproduction. In short, the salmon only goes to sea for one purpose, that of food;† but when that is accomplished, it hastens "home."

Correct interpretation of the age of the fish in its successive stages of parr, smolt, grilse, and salmon is of great importance

* *Life-History of the Salmon*, p. 169.

† This has received a striking illustration in late years from the behaviour of English fresh-water trout introduced to the rivers of New Zealand and Tasmania. They have acquired a sea-going habit precisely analogous to our salmon, and are taken in nets at sea of great size and with a silvery marine livery.

in framing fishery legislation, and a number of data upon that subject have been collected and published in the Report of the Fishery Board for Scotland, 1901, Part II. In 1896, Mr. Walter Archer, at that time Inspector of Scottish Salmon-Fisheries, instituted the system of marking salmon which he had put in practice upon the Sand River in Norway, and this has been continued by his successor in office, Mr. Calderwood. We have now, therefore, before us the results of six years' systematic marking, a period which covers the life of a salmon from the ovum to an adult state, besides the less trustworthy records of previous observers, extending from the year 1823 to 1896.

The first point to be noted is that, *as a rule*, salmon return to the river that they are bred in. The late Frank Buckland declared that they invariably did so, and said he would like to hatch them by thousands in his kitchen, because he was certain that they always returned to the place of their birth. Nevertheless sufficient exceptions to the rule have been noted to show that salmon probably are indifferent to what river they ascend, that they choose the river which happens to be nearest when the homing impulse is felt, and that it is only in a small percentage of cases that they wander so far to sea from the place of their birth as to come within the radius of attraction of another river.

The method of marking adopted by the Scottish Fishery Board is by a silver plate stamped with a number corresponding to an entry in the register, giving details of the weight and condition of fish when captured. This plate is attached by silver wire to the fleshy part of the salmon's dorsal fin. Six thousand of these have been issued to anglers and net-fishers in Scotland during the last six years, as well as 2,500 to persons in Ireland. Of 3,036 fish marked in Scotland, 190 had been recaptured up to the end of 1901. Twenty-four of these fish captured in rivers were retaken in rivers after the lapse of at least one season: of these twenty-four, nineteen

were retaken in the same river as they were first captured in: the other five were as follows :—

Three salmon captured in the Helmsdale were retaken in the Brora.*							
One	"	"	"	Spey	was	"	" Dee.†
One	"	"	"	Spey	"	"	" Deveron.

Out of ten fish marked in rivers and recaptured in salt water, all were retaken near the mouths of these rivers, except one fish marked in the Deveron, retaken at Cove (Aberdeen), about seventy miles to the south-east, and another marked in the Brora, retaken in Bighouse Bay, one hundred miles to the north-west. It is easy to suppose that salmon may be lured to great distances from their native rivers by the movements of shoals of herring or other fish on which they are known to subsist. In Norway a fish marked in the Aaensira River was retaken two years and a half later in Trondjhem's Fjord, fully five hundred miles to the north.

As to the rate of growth and increase in weight, some very instructive tables have been prepared by Mr. Calderwood, both from the observations and markings conducted on the Tweed between 1851 and 1873, and from those of the Scottish Fishery Board initiated by Mr. Archer. Of the fry hatched from ova deposited in winter, it has been ascertained beyond doubt that some descend to the sea as smolts in their second spring, being then about fifteen months old; others delay their migration till their third spring, when they are about twenty-seven months old. In neither case will they exceed two ounces in weight; let them but reach the salt water in safety, and their rate of growth is amazing, if reliance may be placed upon the results of marking in the Tweed.‡

* The mouths of these two rivers are only about twelve miles apart.

† This fish had travelled about ninety miles.

‡ This was sometimes done by fin-cutting, a very untrustworthy method; in the cases cited, silver wire in the gill-cover was used.

Date of Marking.	Description.	Date of Recapture.	Description.
April, 1851	Smolt ($1\frac{1}{2}$ oz. ?)	Aug. 17, 1852	Grilse, $4\frac{1}{2}$ lb.
April, 1854	Smolt, 1 oz.	July, 1855	Grilse, $3\frac{1}{2}$ lb.
May, 1855	Smolt ($1\frac{1}{2}$ oz. ?)	Aug. 6, 1856	Grilse, $6\frac{1}{2}$ lb.
May, 1855	Two smolts	Summer, 1856	Grilse, $6\frac{1}{2}$ and $5\frac{1}{2}$ lb.

The Scottish Fishery Board have, as yet, no returns to show from marked smolts ; but their list of fish marked as kelts and recaptured clean is full of interest. The longest interval between such marking and recapture has been 515 days, in which case a kelt taken in the Spey in March, 1897, weighing 7 lb., was recaptured in the same river in August, 1898, weighing 19 lb. The stages of this fish may be reckoned as follows :—

Spawn deposited	Autumn, 1891 or 1892.
Went to sea as smolt	Spring, 1894.
Returned as grilse	Summer, 1895.
Returned as salmon (8 lb. ?)	Spring or summer, 1896.
Descended as kelt (7 lb.)	March, 1897.
Returned as summer fish (19 lb.)	August, 1898.

Its age, therefore, was five or six years, according to whether it left the river as a smolt in its second or third spring. But it must not be assumed that all fish of 19 lb. weight are necessarily only five or six years old, for the returns of twenty-two kelts recaptured as clean fish seem to show a remarkable variation in the rate of increase, estimated by Mr. Calderwood to range from as low as 77·2 per cent. per annum to as high as 813·9 per cent. per annum. This estimate, however, appears to be fallacious in one important respect, for it is based on the assumption that the rate of increase throughout the year is the same as that between the dates of capture and recapture. Some kelts travel rapidly to the sea, where they will put on flesh at a great rate ; whereas

others, it is well known, linger long in the descent, and cannot increase at all while in fresh water. Moreover, much must depend upon the good or bad fortune of salmon in finding shoals of food-fishes in the sea.

While these pages are going through the press, arrive reports of two marked fish recaptured in the Deveron. The first is a salmon, marked as a kelt, weighing 19 lb. on March 4th, 1902, recaptured in October of the same year, within half a mile of the same spot, weighing 34 lb. The other is a sea-trout (? *S. eriox*) caught as a kelt February 8th, 1902, weighing 3 lb., recaptured on July 19th following, weighing 6 lb.

The prolonged enquiry of Lord Elgin's Commission has been brought to a conclusion by an exhaustive Report lately issued. It is to be regretted that no place has been Water-storage. found therein for what must be regarded as the most important and hopeful of all means of regenerating the salmon-fisheries of Scotland and Ireland—namely, water-storage. It may be asked why, holding that view, I did not bring the subject before the Royal Commission in my evidence. The reply is that I could have offered no more than a *view*. There were then no trustworthy data in my possession. Since then, we have experienced the extraordinary summer drought of 1901, and that season happened to be the first in which the storage-works constructed by the lessees of the Duke of Sutherland's Helmsdale fishings came into operation. A dam was erected at the foot of Badanloch, a large sheet of water on the head-waters of the Helmsdale, whereby the level of the lake was raised several feet. When the drought set in at the beginning of June, the sluices were opened, with the result that the river ran in full order for many weeks. During the whole of that time, fish were able to run freely from the sea, and excellent angling was obtained; whereas, but for the stored water, the fish must have been stopped in the tideway, and angling must have been at a standstill.

Now, important as such an auxiliary is to the sport of angling, it has far wider application than that. It affects the whole salmon-fishing industry. In Norway the physical and meteorological conditions are almost the reverse of those prevailing in this country, although the habits of salmon and their season of spawning are the same. In that country the rivers, fed by snow-fields and glaciers, run full throughout the summer ; salmon can enter them when they will. In winter, when salmon are spawning, the water supply is stopped by frost, and the rivers dwindle as under severe drought. In this country, on the contrary, our rivers are generally high in winter, but are liable to extreme depletion in spring and summer, when fish chiefly would run. The effect of a summer drought is to keep shoals of salmon moving up and down the estuary with the tides, waiting for a flood to carry them up. It is at such times that undue havoc is wrought among them by nets. Whole "runs" of fish are annihilated. All men of experience agree that, in order to maintain the salmon stock in any river, it is necessary that a fair proportion of every run of fish should escape the nets. It is with that view that the Legislature has enacted a weekly close-time ; but what is the use of such close-time if the river is barred by drought to the ascent of salmon? It merely means a heavier haul for the nets on Monday morning. Under an effective system of water-storage, sufficient water might be let down every week-end to allow the fish waiting in the tideway to run up before the nets set to work again on Monday morning. Short-sighted netmen might grudge this interference with their harvest, but the more intelligent ones perceive that it means the prolongation and improvement of their industry. The syndicate which have spent vast sums in acquiring all the nets on the greater part of the Tay, *and suppressing half of them*, have derived such handsome profit from the other half that their investment has already proved to be a splendid one. They do not kill such a large proportion of running fish as

was done under the old system, but their takes are far larger, because the running fish are increasing every year in numbers, owing to discriminate fishing. From ordinary netsmen, discrimination cannot be expected. Fierce rivalry exists among them ; every stone which may shelter a fish or obstruct the net is removed from the channel, and the nets are worked with an industry that could not be exceeded if salmon were a dangerous beast of prey which it were desirable to exterminate. Therefore, in the interests, not only of themselves, but of the persons employed on the nets, upper proprietors must provide means of escape for a due proportion of each run of salmon entering their rivers. Most of the rivers in North Britain and in Ireland lend themselves to water-storage. Their head-waters generally run through uncultivated land of little value ; in very many cases, like that of the Helmsdale, there are lakes whereof the level may be raised by dams at the expense of inundating nothing but moor and bog.

River proprietors are spending more and more upon artificial salmon-hatcheries, in the belief that therein exist the means of replenishing exhausted rivers ; but it is obvious to those who have watched most closely the operations of Nature that, in order to have any effect, artificial hatching must be carried out upon a very considerable scale. Until one has watched the smolts descending to the sea in any ordinarily prolific salmon river, no conception can be had of the profusion of Nature's provision for maintenance of the species. These little fish have survived the initial and tender stages of alevin and fry ; they represent but a small fraction of the produce of a single spawning season ; yet they are in countless swarms ; in places the water is blue with them. In most existing hatcheries no attempt is made to rear the fish to this comparatively robust stage. It is considered that enough has been done if, say, half a million defenceless fry are liberated to take their chance among hostile beasts and birds, fish and insects. From hatcheries where provision is made for rearing

the fry to the smolt stage, perhaps 5,000 or 10,000 may be annually released—a scarcely perceptible recruitment of the swarms which may be seen migrating without the aid of man. The evil done by disturbance of spawning fish in obtaining ova for the hatchery probably far exceeds the infinitesimal good which may be secured.

And note that, even assuming that 1 or 2 per cent. (a liberal estimate) of artificially reared samlets return as grilse or salmon, the advantage, in a dry season, accrues to the netsmen only. The upper proprietors who maintain the hatchery cannot expect to see their fish again, except by the accident of friendly floods. Let them, then, provide machinery rendering them independent of rain. It will be to the advantage of all concerned, whether netsmen or anglers. I feel convinced that if the money now spent on hatcheries were devoted to water-storage, the beneficial effect upon the salmon-fisheries of this country would be direct and permanent.

CHAPTER XV

THE BULL-TROUT AND THE SALMON-TROUT

The Bull-Trout, or Sea-Trout—The Salmon-Trout, or White Trout—Habits
—Angling for Salmon-Trout.

COMING now to consider the various species of trout, migratory and otherwise, we enter upon a group of species and varieties of extreme dubiety. While entertaining profound respect for systematic ichthyologists in general, and for Dr. Günther in particular, I am quite unable to share his belief in the constancy of the ten species which he recognises among British trout, and I propose to deal with them as in three species only, noticing the principal of the numerous local or racial varieties of each.

The Bull-Trout, or Sea-Trout (*Salmo eriox*)

FINS.	TEETH.
As in the salmon.	As in the salmon.

In adhering to the title conferred by Linnæus upon the largest of our migratory salmonoids except the true salmon, I am aware that I must incur adverse criticism from some modern ichthyologists, but I feel that it is safer to retain a term so long associated with a creature with which practical fishermen are perfectly familiar, rather than adopt one about the application of which there seems to be considerable uncertainty. So far as I have been able to follow the maze of description from the pens of many able writers, it has been proposed to give

the scientific name *Salmo cambricus* to what is known as the bull-trout on the Tyne of Northumberland, and throughout Scotland, except on the Tweed, where it is called the sea-trout. But then it appears to me, who have seldom seen it, that the sewin of Wales, designated *Salmo cambricus*, must be a totally different fish in habits and appearance from the bull-trout, with which I am very familiar. I propose, therefore, to say nothing about the sewin, for the very good reason that it could only be a repetition of the description of this fish by other persons, and they are far from agreeing in their accounts. Couch, for example, describes the sewin as having pale pink spots and a deeply forked tail, features quite foreign to *Salmo eriox* of Linnæus, in which the spots are all black, and the tail is always, in adult specimens, nearly square at the end. Mr. Houghton speaks of the excellent qualities of its flesh, and says that it competes with the salmon-trout in esteem as a sporting fish. In neither of these respects is the bull-trout of northern rivers to be commended, for its flesh is very far inferior to that of the salmon, and it comparatively seldom takes a bait or fly except in the kelt stage.

As to the English names of this fish, that of sea-trout is perfectly applicable and correctly descriptive, but so long as the specific distinction is maintained between *Salmo eriox* and *S. trutta*, there remains the objection that throughout Scotland, except on the Tweed, the last-named fish is popularly known as the sea-trout. The term "bull-trout," implying "big or coarse trout," seems peculiarly appropriate to *Salmo eriox*, which runs to a far larger size than any other of the family in Britain, always excepting the salmon. Fig. 3. on Plate IX. shows a bull-trout taken in the net below Perth in June, 1899, weighing 40 lb., and fish of this species are commonly taken in the Tweed from 8 lb. to 15 lb. in weight. The size, therefore, of the bull-trout entitles it to rank next the salmon, to which fish it closely approximates in habits and appearance.

Superficially, the two fish differ from each other in the

thicker proportion of the bull-trout to its length ; it has also a rounder, coarser head than the salmon ; the dark spots on the gill-covers and scales are more numerous and larger. Thousands of bull-trout are eaten by unsuspecting townsfolk as salmon, although the market price for the first is always considerably lower than for the second. The flesh is of the same beautiful "salmon colour," but it is much less richly flavoured, and is of a disagreeable dry texture when cooked. Sportsmen look with no favour upon the bull-trout, because, although it is taken by the same flies and other baits as are used in salmon-fishing, it is a fish far less disposed than the salmon to take any lure whatever. Indeed, the chances of hooking a bull-trout, except in the kelt stage, even in a river swarming with them, are so poor that few men would be at the pains to angle for them.

Bull-trout are very numerous on the coast of Northumberland and Berwick, and are practically the only migratory *Salmonidæ* frequenting the rivers Coquet and Aln. The proprietors of the Coquet, which, in size and character of channel, is all that could be desired for a salmon river, have long held the belief that bull-trout had expelled the true salmon from their stream, and that salmon would return if bull-trout could be put down. Accordingly the Inspectors of Fisheries recommended that the statutory annual close-time should be suspended in the Coquet, and that bull-trout should be destroyed during the spawning season, as well as at other times. This having been done in 1868, the massacre began and was continued for four years, with the following result :—

In 1868,	28,107	bull-trout	were	killed.
In 1869,	17,211	"	"	"
In 1870,	11,457	"	"	"
In 1871,	13,622	"	"	"

Total in four years, 70,397

After that, the undertaking to exterminate bull-trout was

abandoned, and they remain still in undisputed possession of the Coquet.* Now, it is to be noted that both the Coquet and the Aln possess a very large stock of common yellow trout (*Salmo fario*). The late Sir Alexander Gibson-Maitland, who had opportunities, unrivalled in this country, of studying the phases of salmonoid fish in his extensive hatcheries at Howietown, held very strongly the belief that *Salmo eriox* and *Salmo fario* were different forms of the same species, one migratory, the other stationary. He told me that spawn taken from bull-trout produced fish which passed through the ordinary stages of parr and "orange-fin." Under normal circumstances, these would have passed to the sea and returned as bull-trout; but, when prevented from migration, they developed the ordinary character, coloration, and habits of fresh-water trout. I offer no opinion upon this startling statement; but if it should prove well founded (and the experiment is surely worth repeating), it follows that fresh-water trout and bull-trout are interchangeable, and that any attempt to extirpate the latter must include measures for the suppression of the former.

The Salmon-Trout, or White Trout (*Salmo trutta*)

FINS.
As in the salmon.

TEETH.
As in the salmon.

There is the utmost conflict of authority as to the nomenclature and number of species among the anadromous or

* It has been stated, but I am unable to vouch for its accuracy, that there existed until the year 1900 a weir across the Coquet up to which the tide flowed, and that salmon would not attempt to surmount such an obstacle until they were clear of the estuary. The statement proceeds further to the effect that this weir has now been removed, and that true salmon have at last found their way into the Coquet. Seeing that the tide flows up to Teddington Weir, it seems desirable that those who are concerned in the attempt to restore salmon to the Thames should satisfy themselves as to the accuracy of this report.

migratory trout of Great Britain. Dr. Günther has catalogued four separate species under the titles *Salmo trutta*, *S. cambricus*, *S. gallivensis*, and *S. brachypoma*. On the other hand, Dr. Day, while naming two—*S. trutta* and *S. cambricus*—considers that the second is but the southern variety of the first. This is far more nearly in accordance with the observation of unscientific men accustomed to handle and sell these fish, but there remains this difficulty in accepting Dr. Day's definition, that, whereas his *Salmo cambricus* must be taken as intended to include what is known in most parts as the bull-trout (*S. eriox* of Linnæus), it is difficult to rate as a southern form a fish which is peculiarly abundant on the coasts of Northumberland and Berwick.

The shape of the gill-cover, the arrangement of teeth on the vomer, the number of cæcal and pyloric appendages, the number of vertebræ, and the general appearance of these fish—all of which are relied upon to indicate species—are so much subject to variation, and blend so imperceptibly into intermediate forms, that it is safest to hold judgment in suspense for the present, and for practical purposes to maintain those lines of distinction about which there is no manner of doubt in the minds of experienced fishermen. It seems unnecessary to go so far as H. Widegren did in 1863, and as later Continental authorities have followed him in doing—namely, to reduce all the European *Salmones* to two species, *S. salar* and *S. trutta*, in the latter of which he would group all trout, whether regularly migratory and maritime in habit or not. Even if the dominant races of British trout be ultimately proved to be convertible, under uniform treatment and environment, to a single type (which I am far from denying to be possible, and even probable), it seems almost pedantic to refuse specific titles to those types which are perfectly distinguishable by appearance and habit, and which have not yet been *proved* to be interchangeable. I shall therefore venture to define as the salmon-trout (*Salmo trutta*) the fish known in Ireland as the white

trout, in Wales as the sewin, in the greater part of Scotland as the sea-trout, but in the Tweed as the whitling ; and the bull-trout (*Salmo eriox*) as the fish known under that name all over Scotland except in the Tweed, where it is called the sea-trout.*

There is one constant difference between the two fish, even when caught in the same river, to which Frank Buckland is the only writer who has given due prominence—namely, the quality of the flesh. That of the salmon-trout is superb, not so rich as that of the salmon, but delicate in flavour ; whereas that of the bull-trout, though pink in colour, is always dry and insipid.

In appearance the salmon-trout is more elegant than the bull-trout, not inferior to the salmon in symmetry, as may be seen in Fig. 2, on Plate X., which is the portrait of a salmon-trout weighing 18 lb., taken by the net in the Tay in June, 1902.

In many respects salmon-trout are similar in their habits to salmon and bull-trout ; at least, so far as has been ascertained,

Habits. for the proceedings of the salmon-trout at sea, and the extent of their range therein, are still wrapped in a good deal of mystery. In seeking the fresh water they show less seasonal variation than salmon. No doubt clean-run salmon-trout may be found occasionally in rivers with spring salmon, but these are only chance wanderers ; the movement of the main body is nearly simultaneous on all parts of the British and Irish coast. It is very well marked by the appearance of shoals of large fish in the estuaries about the middle of May, few being less than $2\frac{1}{2}$ lb. in weight, many reaching 5 lb. or 6 lb., with exceptional individuals far in excess of that. Water permitting, they will ascend the rivers early in June, but in small rivers they often have to hang about the tidal pools for weeks waiting for a flood. At such times, if netting is permitted in the river, their numbers are sorely reduced, and

* Dr. Günther objects to the use of the term "bull-trout" as not being "attributable to definite species," but it is at least as much so as "sea-trout," which he does not hesitate to use.

but few of these early fish escape to the spawning-beds. If inspectors and water bailiffs are on the alert to insist on the statutory minimum of mesh— $1\frac{3}{4}$ inch from knot to knot *when wet*—every fish weighing 2 lb. and under ought to get through the net ; but it is within my own knowledge that the law is pretty commonly evaded in this respect, and a much smaller mesh employed. Even where the mesh measures no less than $1\frac{3}{4}$ inch from knot to knot *when dry*, it contracts far within these limits so soon as it is put in the water.

As the season advances, salmon-trout continue to run from the sea, but show a marked diminution in size, until, at the beginning of August, great shoals of small salmon-trout, from half a pound to one pound in weight, make their way into the rivers and brooks. These are the equivalent in age of the grilse of salmon ; that is, they are virgin salmon-trout, leaving the sea for the first time, and are known in different localities as finnock, herling, whitling, whiting, etc. Once they get into a river with a good leading head of water, salmon-trout run up to their appointed ground much quicker than salmon. If the river run through a lake, they will tarry awhile therein, behaving exactly like their non-migratory kin ; but when gravid they hasten to the spawning-grounds, deposit their ova, and are off again as kelts to the sea at much greater speed than salmon. In many rivers they show a peculiar and inveterate preference for certain tributaries, and desert the main stream for these, in some instances when the favoured affluent joins it only a short distance above the tide.

The local names of the salmon-trout are numerous and varied. On the Tees it is known as scurf, or cochivies ; in Scotland generally as the sea-trout, except on the Berwickshire coast, where that name is applied to the bull-trout ; in Cumberland as mort ; and on the Tweed as whiting, or whitling, though that term is generally restricted to this fish in the grilse stage, corresponding exactly to the Highland name for it, finnock—*i.e.*, *fionach*, the white fellow. Elsewhere in Scotland these

grilse salmon-trout are known as herlings, blacktails, and Lammasmen, from their annual appearance at Lammastide, in the beginning of August. Sprod, in the north of England, usually means this fish in the smolt stage, descending to the sea, though here again the name is sometimes applied to them when they reach the grilse, or herling, stage. In Ireland salmon-trout are generally called white trout, in distinction from the yellow or brown trout of fresh water.

There be some men who aver that fishing for sea-trout is finer sport than can be had with salmon. Certainly, when there are plenty of fish in the water and the river is in trim, there are few more exciting diversions than salmon-trout afford to the fly-fisher. The sport is in perfection when the stream is of such size as may be commanded by a single-handed trout rod, nine or ten feet long. With two flies of modest dimensions, a medium fine gut-cast, and fifty or sixty yards of running line, the angler ought to be able to manage anything he is likely to encounter. It is true, he may chance to hook a twenty-pound salmon; even a six-pound salmon-trout will lead him a pretty dance; but the ideal stream for salmon-trout is one that can be commanded from bank to bank with such tackle as I have described; and if the fish takes to running, the fisher must run too.

In larger rivers, a longer rod is necessary, but on no account must it exceed fifteen feet, though it will be advisable to have at least one hundred yards of line upon the reel. By using thirty yards of relatively heavy silk line for casting, backed by seventy yards or more of the fine, but amazingly strong, undressed silk line made for tarpon-fishing, the whole can be packed away in a reel of very moderate dimensions. To use heavier tackle and a longer rod than these, even in the great rivers of Norway, is to forego half the charm of angling for these lively fish. The brisk, dashing rise, the rapid rushes and frequent leaps they make when hooked, lose their piquancy through the medium of an eighteen-foot salmon

rod ; besides which, the frequent casting required becomes excessively fatiguing.

No fish exceeds the salmon-trout in silvery lustre when fresh from the sea, but they soon lose it in fresh water and become dark and discoloured. Fig. 2, Plate X., shows a salmon-trout weighing 18lb., taken from the Stanley water on the Tay in June, 1902.

As a rule good sport is only to be expected when the river is subsiding after a flood ; but there are many lakes in Scotland and Ireland where salmon-trout collect in great numbers and give splendid sport. Even in rivers, when the water is dead low, heavy baskets may be filled by fly-fishing at night. The weather must be warm for this sport, and the daylight must be quite gone, or as nearly gone as it ever is in the northern counties in July and August. There are generally certain pools just above the tide into which salmon-trout struggle by scores in times of drought. Taking your stand at the foot of one of these about ten o'clock, you may hear the fish rattling the shingle as they scurry through the shallows. Then cast a single fly—it matters not whether white or black, red or green—up-stream into the pool ; you will see nothing, for the pool itself is one expanse of blackness, or at most you will discern but a sparkle of reflection from the stars, but presently you hear a sound between a suck and a splash, or maybe a spanking clatter in the water—strike home, and you are in him ! but keep a light finger on the line, for the slightest check to one of his lightning rushes will smash the tackle, and it is a grievous task to repair damages in the dark. At such times even the best disciplined lips have been known to emit deplorable ejaculations.

To the novice in this mode of fishing it is exceedingly fascinating. The mere fact of being abroad in the fragrant night at an unfamiliar hour ; the silence, broken only by the river tinkling over the shallows, by the distant throb of the tide, or the cry of some passing night bird ; the



Photo by P.D. Malloch.

$\frac{2}{5}$ Natural Size

THE COMMON TROUT (*Salmo fario*)
Northern variety

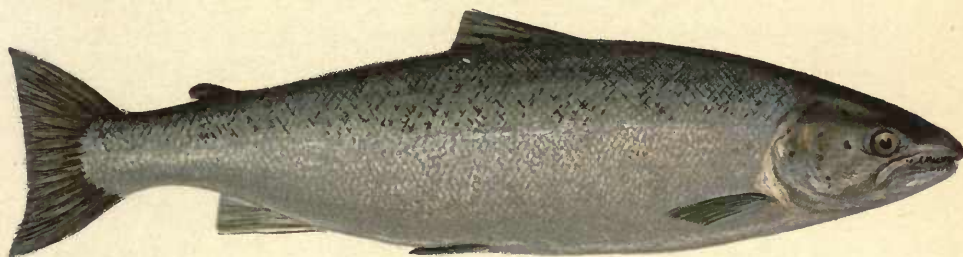


Photo by P.D. Malloch.

$\frac{1}{2}$ Natural Size

THE SALMON TROUT (*Salmo trutta*)

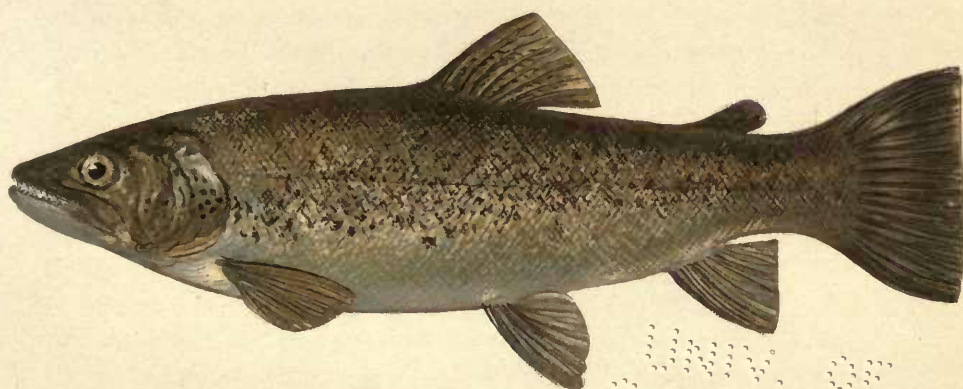


Photo by W.P. Dando.

$\frac{1}{2}$ Natural Size

THE COMMON TROUT (*Salmo fario*)
Southern variety



glimmering, solitary landscape and the cool breath of the stream—all these enhance the excitement of catching lovely fish, which to angle for in broad day, under existing conditions of weather and water, would be a pastime only for lunatics.

In additon to the sewin (*Salmo cambricus*) and the salmon-trout (*S. trutta*), which I have ventured to regard respectively as southern and northern variants of the same species, Dr. Günther, who omits the bull-trout (*S. eriox*) from his list, recognises two other migratory species in British waters—namely, the grey trout (*Salmo brachypoma*), which he describes as frequenting the Forth, the Tweed, and the Ouse, but which I incline to follow Dr. Day in considering no more than an adolescent or grilse form of *Salmo trutta*; and the Galway sea-trout (*Salmo gallivensis*), which is neither more nor less, I believe, than a river trout (*Salmo fario*) with saline propensities, causing it to seek food in the estuaries, without going out to sea like the regular sea-trout. I am not acquainted with the so-called Galway sea-trout, but am very familiar with what I take to be a similar fish in Scottish streams. This is obviously the common brook-trout, which, descending below tide-mark, often when its native burn has no estuary, but brawls over shingle and sand into the sea, acquires a silvery jacket, but retains some of the spots of the inland race. In large estuaries these river-trout attain a very great size. One was taken in the Tay on June 25th, 1902, weighing 17 lb.

CHAPTER XVI

THE COMMON TROUT

The Common or Brown Trout—Its Variability—Doubtful Permanence of So-called Species—Food of Trout—Trout-fishing.

The Common or Brown Trout (*Salmo fario*)

FINS.
As in the salmon.

TEETH.
As in the salmon.

THE name "trout" seems to have had an origin in the term applied to fish in general by primitive man. The Greek *τρώκτης* means a gnawer, a nibbler, a greedy creature, from *τρώγειν*, to gnaw, and was applied to some kind of marine fish with sharp teeth; from the Greek probably came the Latin *tructa* and the French *truite*, but we derive our form of the word through a different channel, for it appears in Anglo-Saxon as *truht*. It is a term well fitted by its root meaning to denote a fish so insatiably predaceous as our brown trout is by nature, albeit long and painful experience of the malice of man has rendered it shy and suspicious. The most incorrigible human *gourmand* might learn to be abstemious if the dangers lurking in too frequent calipash and calipee and too copious draughts of Perrier Jouet took the tangible form of barbed steel, instead of the more subtle and even deadlier agencies of dyspepsia and uric acid.

Professor Seeley tabulates no fewer than twenty-four species of fresh-water trout in Europe, besides five migratory species, but the extreme variability of the whole race of trout

renders highly untrustworthy the points of difference in fin-rays, form of gill-cover, dentition, and number of pyloric appendages, which have been relied on as specific distinctions. I possess a small lake, some six acres in extent, of exceedingly clear water supplied by springs. It has been formed out of an old marl pit, and about thirty years ago I introduced trout into it. The water being very rich in insect and crustacean life, the fish have thriven amazingly ; but, owing to the absence of suitable running water, they are unable to fertilise the spawn which forms in their ovaries at the usual season. Accordingly I have kept up the stock by turning in trout nearly every year since the beginning ; with this result, that, whatever difference, specific or otherwise, might be apparent in the fish at the time they were turned in, after two seasons, at most, it became absolutely impossible to tell from their external appearance to what variety they originally belonged. Whether they had been small trout from a neighbouring stream, distinguished by conspicuous red spots, very distinct parr-markings, and a predominance of yellow in their colouring, or other small trout much darker and less shapely from a more distant stream, or Loch Leven trout (*Salmo levenensis* of Günther)—all assumed when in prime condition a very silvery appearance, with not more difference among them than is apparent among sheep of the same flock. Fingerling trout which, if left in their native burn, would never have weighed a third of a pound, grow rapidly under the favourable conditions of this little loch to three and four pounds in weight. The deposit of guanin under the scales is so uniform as to supply a complete disguise ; the parr-marks completely disappear ; so also do most or all of the red spots ; and I have taken some which, had the loch possessed any practicable connection with the sea, I should have pronounced at first sight without hesitation to be salmon-trout.

Of peculiarities in the internal structure of these fish I cannot speak with confidence ; but surely it is unsafe to found

too much upon these in a creature of such a plastic nature. The number of vertebræ, for instance, is often relied upon as an indication of species, yet the uncertainty of this test is manifest if we accept Dr. Day's assurance that he has found these vary in British fresh-water trout from fifty-six to sixty.* Again, the number and size of cæcal appendages have been cited repeatedly as a guide to species. Parnell, Yarrell, and Couch distinguished the trout of Loch Leven as *Salmo cæcifer*, because of the superior development of these appendages to the intestine ; but here again there is nothing like fixity. Common Scottish trout have been found with as few as twenty-seven, and as many as sixty-nine ; while in Loch Leven trout themselves they have been found to vary between forty-eight and ninety. Now these pyloric cæca are secreting tubes, closed at the outer end, situated along the small intestine, and their function is supposed to be that of a supplementary pancreas. It is probable that their development varies, not according to the species, but in proportion to the amount and quality of food. Where food is deficient, there will be the less exercise for these organs, which will show a tendency to diminish in size and number ; where it is abundant, rich, and stimulating, they will tend to develop as aids to nutrition.

These considerations have led me to adopt the view of those ichthyologists who regard all British fresh-water trout, if not all European ones, as varieties of a single species. Lunel proposed to include all the four so-called species of Lake Constance, defined as *Salmo fario*, *lemanus*, *Rappii*, and *lacustris*, under the single title of *Salmo variabilis*, and in truth no more appropriate title could be desired ; because not only do these fish acquire modified organic characteristics under the influence of food, its quality and abundance, and of such physical environment as soil, water, and climate, but fish reared from eggs out of the same ovary undergo such rapid change of colour and markings according to the bottom they swim over,

* *British and Irish Salmonidæ*, p. 189.

as to appear creatures of totally distinct species. Fatio, writing about the trouts of Central Europe, observes : "The little brook-trout which most zoologists distinguish under the name of *Salmo Ausonii* is truly, in my opinion, nothing more than a form of the great trout of our lakes, which is called, according to circumstances, *Trutta lacustris*, *Trutta Schiffer Mülleri*, *Fario Marsiglii*, or *Salmo lemanus*. Most of the characters proposed for its distinction are those of the early age of the fish. In a small stream the trout, which cannot grow for want of room, arrives at an advanced age, retaining more or less of the character of infancy."

Even so in this country. Taking two lakes in Central Scotland within four miles of each other in the forest of Corrour—Loch Ossian, a little more than three miles long, and Loch Treig, about seven miles long—we find the most striking contrast in their trout population. No salmon or migratory sea-trout obtain access to one or other. Loch Ossian is comparatively shallow, and swarms with small trout about six or eight to the pound. You may fill a barrow with them by fly-fishing on a mild day, and never get one weighing more than a quarter of a pound. Moreover, every fish retains the juvenile parr-markings, and the flesh is white or lightly tinged with pink. The food supply of the lake being a fixed quantity, it has to be sub-divided among millions of mouths, whence it comes that the trout of the lake are all dwarfs. It is very different in Loch Treig, which is of immense depth—one of the requisites indispensable to the production of that class of trout which Dr. Günther distinguishes as the Great Lake Trout of North Britain, Wales, and Ireland (*Salmo ferox*).

Ferox of great size inhabit Loch Treig, and the rest of the trout therein are goodly fish, running commonly from $\frac{1}{2}$ lb. to 2 lb. I "say the rest of the trout"; but who is to declare which are *ferox* and which are *fario*? Is it a question of size? Then I ask the reader to what species does he assign the great silvery trout of the Thames, running up to 12 lb.

in weight? Or I will ask him to accompany me to Romsey on the Test. There he shall see under a bridge below the town a deep pool, just within the park of Broadlands, whence every year are taken one or two enormous trout, apparently identical with the so-called *ferox* of Loch Treig and other Highland lakes. Now in the Test there is no question of a different species. These Romsey monsters were once modest little parr-marked brook-trout. Favoured by fortune or superior mettle, they have happened to take up their abode in this pool below the bridge, where they thrive prodigiously on the offal which comes to them abundantly from one of the town sewers. Like *ferox*, they disdain the artificial fly, but seize a prawn, a minnow, or even a good lob-worm dangled conveniently before their noses. I have seen one so taken in this pool weighing $11\frac{1}{2}$ lb.; as I write I have before my eyes the stuffed skin of another which weighed 8 lb., as well as that of a third of 6 lb., which took my floating sedge in most gentlemanly manner in a shallower pool a little way down the same river.

Now, any one of these trout, had it been taken with a minnow in profound Loch Treig, would have been hailed as *Salmo ferox*. In a lake not five-and-twenty miles in a crow-flight from Loch Treig—Loch Arkaig, to wit—I once went afloat at 3 p.m., and returned at seven with five trout, weighing respectively $17\frac{1}{2}$ lb., 8 lb., 5 lb., $2\frac{1}{2}$ lb., and 2 lb. Having been taken by a spinning-bait, a small burn-trout, they were all indubitable *ferox*, of course; but who would have so termed the three smaller fish had they been taken with the fly?

Again, if *Salmo ferox* is a distinct species, how are the young and adolescent forms to be distinguished from the common trout of any lake? Nobody has ever attempted to point that out; yet it is surely incumbent upon those who claim these great trout as a separate species to explain what they are like before they become great. The simplest expla-

nation here is the likeliest—namely, that in great and deep lakes, fed by countless streams nourishing immense numbers of small trout, all the trout would remain small, were it not that some of their number, favoured by ample depth and expanse of water and by their own superior energy, gradually obtain some advantage, become so much larger than their fellows, that, when pressed for food, they take to preying on their own kind. For these so-called *ferox* have well earned the title of ferocious, being habitual cannibals. The result is to the advantage of the community, for it is to be noted that in lakes fed by numerous streams affording unlimited spawning-ground, trout will multiply up to the very limits of subsistence, but all will remain insignificant in size, unless pike or *ferox* are present to act as a check upon numbers, in which case the average weight of the trout will be considerably greater, and their quality better, through the reduction of the number of mouths to feed.

It may be observed, parenthetically, that it would be an exceedingly rash proceeding to introduce pike into a lake which is overstocked with small trout in order to increase their size. The proper course to that end is to limit the spawning-ground by erecting impassable barriers upon some of the tributary streams, at the same time doing all that is possible to improve the food supply.

Before dismissing the so-called *Salmo ferox* as a mere variant, full or overgrown, of the common trout, it is to be noted that, as in all the rest of the species, much of the external colour is exceedingly transient. Sometimes *ferox* from 8 lb. to 15 lb. are grey and silvery when landed; at other times they are intensely dark, with numerous spots and fiery sparkles. But I have seen some of these dark monsters, left in a cool place overnight, appear quite bright and salmon-like in the morning. In fact, it is impossible to judge of the permanent skin colour and markings of any trout unless it is wrapped in a wet cloth and so left for some hours.

The grounds for reckoning the trout of Loch Leven as a distinct species (*Salmo levenensis*) have been submitted of late years to more searching analysis than has been applied to the case of the *ferox*. Prolonged observation in the Loch Leven hatchery and other similar establishments has tended to show that, although pure Loch Leven trout maintain their distinctive outward character longer than most local varieties of trout submitted to novel environment, yet the tendency is to assimilate with trout from other waters. The excellent and abundant food in Loch Leven, enjoyed for centuries by the fish in that favoured mere, has resulted in the establishment of a superior variety of trout; but no such permanent changes in structure have taken place as seem to me to constitute a species. Loch Leven trout are distinguished by their somewhat slender form compared with those in other waters, probably arising from the rapidity of growth in consequence of stimulating and plentiful nourishment. They are also more silvery than most fresh-water trout, with less yellow along the sides of the abdomen, and the spots are large and dark, without any scarlet. The Gillaroo trout of some of the Irish loughs has been classed by Dr. Günther as a separate species, *Salmo stomachicus*, on grounds which appear to me even less tenable than those which sufficed for the Loch Leven trout. The sole constant difference seems to be that the integument of the stomach is three times as thick as that of an ordinary trout, which is supposed to arise from this fish feeding to a large extent upon shell-fish. Speaking with all diffidence, I submit that there is nothing that has been ascertained about these trout to establish them as more than well-fed, well-grown specimens of *Salmo fario*, attaining the weight of 10 lb., and seldom caught under 2 lb. in weight. The same Gillaroo represents the Irish *giolla ruadh*, red fellow, indicating the orange and rosy tints of the skin which distinguish it, when in fine condition, from the silvery coated trout which are caught in the same lakes.

I have already (page 257) ventured to express dissent from

Dr. Günther's classification, and suggested that his *Salmo gallivensis*, the Galway sea-trout, *Salmo estuarius* of some other writers, and *Salmo orcadensis*, the Orkney trout, are only common brown trout manifesting saline propensities, and acquiring robust proportions and features in consequence of rich estuarine diet. They are known in some of the Irish estuaries as slob-trout. A magnificent specimen of this variety was taken in Loch Stenness, Orkney, weighing 30 lb. A cast of this fish was taken by Mr. Malloch, of Perth, and may now be seen in the Fly-Fishers' Club, of London. The following account of its capture was written in 1902 by William McLeod, Bridge of Waithe, Stenness, and published in the *Fishing Gazette* :—

"I caught it on March 15th, 1889. I was, during that month, fishing long lines in Stenness for flounders and cod, and I used long-worm or sand-worm for bait.

"I had the previous evening set a long line at the edge of the shallow water, just where the deep water begins along the shallow at the point of Onstone. I went out about nine o'clock in the forenoon to lift my line. I had taken in a good piece when I felt something very heavy, and after a piece of the line had been hauled, the fish made his appearance and jumped. I did not know for the moment what it was, but I knew I could not get it into the boat without a gaff, and I had none with me at the time. I had no chance but to cut the line and put a piece of wood or something that happened to be in the old boat to keep it afloat, and threw the lot overboard. I then rowed down to the Bridge of Waithe, about a quarter of a mile or so, for a gaff, and then rowed up again to where I threw over my floating affair. After looking about a bit, I saw it and got hold of it. The trout was still on, but had played itself pretty well out. I got it alongside and gaffed it into the boat. The boat was small and low in the water, and I thought it would jump overboard again.

"I took it to Stromness, and sold it to Mr. McKay, hotel-keeper, who has set it up in the Stromness Hotel. It weighed

30 lb. when taken out of the water, and measured 3 ft. 2 in. in length and 2 ft. in girth.—Yours truly,

“WM. McLEOD.”

To which Mr. R. B. Marston, editor of the *Fishing Gazette*, added the following note:—

“I always look upon this as the finest trout I have ever seen, even a handsomer fish than one of the same weight caught in the Lake of Geneva, which I saw some twelve years ago.”

Of Dr. Günther's third species, *Salmo nigripinnis*, the black-finned trout from Welsh mountain tarns, also called *S. cornubiensis*, the Cornish trout, I cannot speak from observation; but I remain very sceptical about the permanence of the features which have been relied upon as specific.

Now, as to the outward appearance of our common trout, it is very difficult, owing to its variability, to give a precise description. Moreover, there is the widest possible difference in the same individual at different seasons. The most usual coloration of an adult trout in the best condition—say in the month of June—consists of a brownish or olive ground tint, passing into gold on the flanks and pure white on the belly. The back varies from nearly black to olive green or pale brown; the dorsal fin and sides are more or less thickly spotted with black, in most instances mixed with smaller spots of bright scarlet. Trout often retain through life the parr-markings—those dark vertical bars so characteristic of the young of salmonoid fish; but that is only the case when want of space or food interfere with their development in size. It is very seldom that these bars can be detected in a fish of 1 lb. and upwards. The skin of the body is covered with minute thin and circular scales, which reflect a metallic or roseate lustre, making it difficult to define the real ground tint; but all these shades and hues are subject to modification or concealment by the deposit of guanin under the scales, consequent upon certain favourable conditions of water and food. When

that takes place, the fish assumes the silvery livery of the sea-going species, and can scarcely be distinguished from salmon-trout. Usually, however, even in these specimens, there remains a tinge of yellow on the flanks, and a greater tendency to spots on the sides than there is in the sea fish.

In contour a well-conditioned trout is nearly as graceful as a salmon, but the head is usually more obtuse and the body of thicker build. As in migratory salmonoid fish, so in freshwater trout, there is a marked difference in the appearance of the sexes after they attain full development. The head of the male becomes much larger than that of the female, the lower jaw tends to be hooked, owing to the growth of a cartilaginous knob on the upper surface of its apex, similar to that of a salmon, and there is often a marked tendency to golden tints in the male and to silvery in the female.

Beautiful creatures as trout become in the height of the season under the influence of plentiful diet, they undergo a melancholy metamorphosis at the approach of the spawning season, which ranges, according to locality, from the middle of October to the month of January. The iridescence and metallic lustre of their skins fade away, sooty darkness spreads over the sides and throat, the body becomes slimy and disagreeable to the touch, and the fairy-like creature of midsummer is scarcely to be recognised in the repulsive animal that frequents the gravelly shallows at midwinter. Their general spawning operations are very similar to those of salmon on a smaller scale, with this important difference, that, whereas a salmon celebrates his nuptials fasting, trout feed ravenously all the time, and of nothing are they fonder than of the ova of salmon. After spawning they soon regain a good deal of brilliancy, but remain lank and emaciated far into the spring months. Small trout, weighing $\frac{1}{2}$ lb. and under, in some waters are in fairly takable condition in the month of March; but the larger trout of the Hampshire rivers and the Scottish and Irish lakes ought not to be angled for before the month

of May. When they arrive at prime condition their flesh is sometimes as red as that of a salmon ; at other times it remains white, but not necessarily inferior in flavour. The cause of this change doubtless is to be found in the food of the fish, but the precise agent producing it is unknown.

The trout is a ravenous feeder, and far from fastidious as to the material of its meals ; but, like most fish, for uncertain

Food of periods and under unknown influences it sometimes
Trout. refuses all kind of food. Crustaceans, molluscs, aquatic larvæ, minnows, and other small fish, flies, and worms are all acceptable in turn. The phenomenon of trout "coming on the rise" is one with which fly-fishers are very familiar, and for which they keep an eager look-out, because it means that swarms of some species of subaqueous larvæ have suddenly and simultaneously begun to pass from the stage of pupa to that of imago, or perfect fly. The trout, which have hitherto been preying upon what living animals they could find on the bottom or in mid-water, become greatly excited, follow the emerging flies to the surface, which is dimpled all over by the fish as they suck them down in myriads. This is the fisherman's opportunity. By casting his counterfeit imitations of the prevailing fly deftly, and keeping himself well out of sight, he reaps his reward.

The art of fly-fishing for trout is such a complicated and difficult one that it would take a whole volume to describe its practice—nay, have not whole volumes, many scores of them, already been devoted to the mystery ? Therefore I will say no more in this place, save that it is the most sportsmanlike and delicate way of capturing these pretty fish. The minnow, natural or artificial, certainly takes larger trout than can usually be tempted to rise to the surface lure ; with the worm they may be hauled out of flooded streams without the exercise of much skill ; but with the artificial fly success is only to be scored by the clumsy and inexperienced where trout have not yet learnt to dread the wiles of men. And how soon they come

to learn these ! It is one of the puzzles besetting the subject of intelligence in the lower animals that successive generations of trout evince progressive suspicion of man and understanding of his devices. There seems to be a complete bar to the transmission of intelligence from parent to offspring, for not only does the spawn lie neglected in the bed of the stream for many weeks, but the fry remain completely apart from the older fish for months and even years after hatching. Indeed, it is difficult to imagine young fish receiving instruction from their elders at any period of their growth, inasmuch as a fingerling trout in the vicinity of a hungry three-pounder runs a parlous chance of being snapped up as part of the larger fish's breakfast ; and at all stages it may be seen how jealously greater trout resent the approach of smaller ones. The trout is essentially solitary in habit ; for, although there may be many trout in a single pool of a river, each one has its chosen station, from which it drives off every smaller fish which may attempt to share it.

In spite of this isolation, trout of very tender age are able to distinguish between man and quadrupeds from which they have nothing to fear. I was particularly impressed by this power of discrimination one day when fishing a stream in Hertfordshire. I discerned, from a safe distance, several trout, large and small, rising in a certain reach of the river. Two or three heavy young cart-horses were galloping about the meadow, thundering along the bank close to these trout, which manifested no alarm, but continued rising in the most alluring way. I took up my rod and prepared to approach these fish with all the craft I knew. The keeper, before whose door I was standing, thinking to do me a service, sent his little girl, a tiny mortal of about seven years old, to drive the horses away. This she did effectually, running along the bank, but she also put down every trout. Now, by what power did these fish, which had shown themselves perfectly indifferent to the great cart-horses, discern danger in this light-footed atom—an immature female specimen of the arch enemy *Homo sapiens* ?

Artificial propagation, of the results whereof upon the stock of salmon in any river one has to speak with the reserve proper to imperfect experience, has been applied to trout with perfect success and certainty. A large number of commercial hatcheries have been established in various part of the United Kingdom, and there is now no difficulty in obtaining eyed ova, fry, yearlings, or mature trout for the purpose of stocking or replenishing lakes and streams.

CHAPTER XVII

THE CHAR AND THE SMELT

SUB-GENUS SALVELINUS

REFERENCE has been made above to Dr. Günther's arrangement of the genus *Salmo* in two sub-genera: (1) *Salmones*, or true salmon, distinguished by bearing teeth throughout the length of the vomer; and (2) *Salvelini*, or chars, bearing teeth only on the head or forepart of the vomer. It must be owned that this is not a very convincing distinction, seeing that the teeth on the vomer of the *Salmones* are not persistent through life. As Dr. Günther himself has explained, these vomerine teeth "at an early age are gradually lost from behind towards the front, so that half-grown and old individuals have only a few (1—4) left." Still, the dentition of char is very constant, and affords a convenient means of distinguishing between two groups of the genus *Salmo*, which, although they have much in common, differ pretty constantly in habit and appearance. But whereas I find the same difficulty in understanding Dr. Günther's motive in subdividing the British char into six separate species as presents itself against accepting his treatment of fresh-water trout, I shall deal with the British char as a single species branching into local varieties. Probably agreement upon the number of species to be recognised among the chars could only be arrived at after careful experiments, consisting of rearing quantities of each variety and submitting them to uniform physical environment, in order to test whether

the distinctions relied on would remain permanent under altered conditions. Unluckily, such experiments must be regarded as almost, if not quite, impracticable, owing to the depth of water which is essential to adult char.

The name char, or charr, is assigned by Professor Skeat to an origin in the Gaelic word *ceara*, signifying "red," a very appropriate epithet for fish which not only often have pink flesh, but display brilliant hues of red and orange in the breeding season.

The distribution of the chars is very remarkable. Confined to the northern hemisphere, various species exist in Europe, Asia, and America. The largest and most remarkable of these is only found in the Danube and its tributaries, *Salmo hucho* rivalling the salmon in size. The so-called brook-trout of North America also is a char, *Salvelinus fontinalis*, and has been reared successfully in great quantities for naturalisation in Great Britain; but something in our waters is displeasing to it, and it invariably disappears, apparently descending rivers and escaping to sea.

The Char (*Salmo alpinus*)

FINS.	TEETH.
<i>First Dorsal</i> : 12 or 13 soft rays.	As in the salmon, except that the vomer bears teeth only on the head, or forepart.
<i>Second Dorsal</i> : Rayless, adipose.	
<i>Pectoral</i> : 13 or 14 soft rays.	
<i>Ventral</i> : 9 or 10 soft rays.	
<i>Anal</i> : 12 soft rays.	

If the distribution of the chars in general is remarkable and puzzling, still more so is that of the British species, which abounds in Lapland and Scandinavia, occurs in the Hebrides and the Orkney Islands, and in isolated sheets of water in Scotland, Ireland, and the north of England. A very closely allied species or variety has been distinguished in Iceland under the name of *Salvelinus*, or *Salmo, nivalis*.

Photo by P. D. Malloch



$\frac{2}{3}$ Natural Size

THE CHAR (*Salmo* [*Salvelinus*] *alpinus*)

Photo by P. D. Malloch



$\frac{2}{3}$ Natural Size

THE GRAYLING (*Thymallus vulgaris*)

The char differs in habit from the brown trout (*Salmo fario*), with which it has such close affinity, in being intensely gregarious, in haunting and feeding in very deep water, and in spawning in large shoals without any necessity for running water. Deep water is more than a matter of preference with char—it seems to be a necessity of their existence. Formerly they were abundant in Loch Leven, but that fine sheet of water was reduced by drainage in 1830 to the extent of four feet and a half in depth, and forthwith the char disappeared, the last recorded capture being in 1837. Char only resort to the shallow parts of lakes in the breeding season, which is the same as that of trout—namely, in late autumn and early winter. At such times it is the practice to net them in Scotland, where they are seldom taken at other seasons, owing to the depth at which they lie. This used to be the case in the English lakes also, but in 1878 a legislative close-time was enacted for char in England, extending from October 2nd to March 31st, both days inclusive. The char of Windermere manifest a singular diversity from the usual spawning habits of their kind. Most of them spawn like the char in Buttermere, Coniston, and the other lakes of the Cumberland district, namely, in the shallow water of the lake itself, but others affect running water. In autumn they enter two rivers, the Rothay and the Brathay, flowing into Windermere in the same channel; but they will not tarry in the Rothay. They leave it almost at once and run up the Brathay, which is fed from Grasmere and Rydal Water, and has a temperature several degrees lower than the Rothay. Trout, on the other hand, spawn in both rivers. This preference shown by char for the Brathay was noted two hundred years ago by Sir Daniel Fleming, and has been fully confirmed of late by Mr. John Watson, the leading authority on the fish of the English lakes.*

In England char are found only in Windermere, the lakes of Coniston, Crummock, Ennerdale, Haweswater, Buttermere,

* *The English Lake District Fisheries*, by John Watson, 1899.

Wastwater, Ullswater, Gaitswater, and Seathwaite Tarn. Attempts to establish them in other lakes have failed. For instance, a number of years ago char were turned into Potter Fell Tarn, about four miles from Kendal, an excellent trout lake, apparently very suitable for this mountain-loving fish. They seem to have migrated in search of more suitable quarters, for, twelve months after the experiment, one was caught with the fly weighing half a pound in the river Kent. All these English char are of the variety known as Willughby's char (Dr. Günther's *Salvelinus Willughbii*). The back is very dark green, almost black, passing into sea-green on the sides, with silvery reflections, and spotted with red; the belly is deeply stained with carmine and orange. The ventral fins are red, with a white anterior margin; the anal fin is reddish also, with a similar white margin; the pectoral fins are greenish, with a white anterior margin, and stained with red on the posterior margin. The first dorsal and caudal fins are blackish.

In Scotland char have been reported from Loch Leven, where they are now extinct; Loch Inch, in Strathspey; in the Lochs Rannoch, Assyut, Altnacalgach, Tay, Dochart, and many others, especially in Sutherlandshire, also from the Hebrides and Orkney Islands. In the southern uplands of Scotland, where there are an immense number of deep lochs, they are only found in Loch Grannoch and Loch Dungeon, in the Stewartry of Kirkcudbright, and in Loch Doon, in Ayrshire.

The distribution of char in this district, one with which I am very familiar, offers a most perplexing problem. I can suggest no cause for their presence in these three sheets of water only, and their absence from many other lakes in the neighbourhood, to all appearance equally suitable to their requirements. The char of Loch Grannoch and Loch Dungeon resemble the Windermere fish in appearance, and rarely take the fly; those of Loch Doon are of a different type, and

are often taken by trout-fishers. Specimens of these Doon char were sent by Mr. Service, of Maxwelltown, to Dr. Günther, who pronounced them to be the true *Salvelinus alpinus*.

Most of the Scottish char belong to the variety classed as *Salmo* or *Salvelinus alpinus*; but those of Loch Bruaich are described by Dr. Günther as identical with the char of Windermere, and are therefore assigned by him to the species *S. Willughbii*; while he makes a distinct species, *S. killinensis*, of the char from Loch Killin, in Invernesshire, in virtue of the extraordinary development of its fins, the pectoral fins, especially, being nearly as long as the head. Loch Killin is a very secluded sheet of water, 2,000 feet above the sea. The char inhabiting it are said to be of a browner tint than those of England and the rest of Scotland, and dull yellow takes the place of brilliant red in the lower parts.

The char of Wales, again, or Torgoch, as they are called in Welsh, have been given the honour of specific distinction under the title of *Salmo* or *Salvelinus perisii*. But how slender is its claim to specific rank may be seen from Dr. Günther's explanation that it rests only upon the existence of a certain membrane, which is produced into a small flap covering the anterior segment of the nostril. The Torgoch inhabits Llanberris, Llyn Quellyn, and a few other mountain lakes, and is a very beautiful fish, of graceful form, sea-green on the back, yellowish on the sides, which are ornamented with many reddish-orange sparkles, and vivid red on the lower parts. The cheeks and gill-covers are thickly spotted with black.

Passing to Ireland, char are found irregularly distributed from Donegal in the north to Cork county in the south. There are two varieties classed as species by Dr. Günther, *Salvelinus Grayi* and *S. Colii*. The last-named variety is found in Lough Eske, in Donegal, and Lough Dan, in Wicklow, and is said never to exceed eight or nine inches in length. They retain the parr-markings permanently, and the belly of breeding males assumes a delicate rosy tint instead of the fiery hues

displayed by English and Welsh char. *Salmo (Salvelinus) Grayi* is the "fresh-water herring" of Lough Melvin. The pectoral fins are longer than those of Cole's char. Both varieties are marked with pink or orange spots on the sides.

British char do not take high rank as a sporting fish owing to their chronically abysmal habits; nevertheless, they are ^{Angling for} highly prized by sportsmen on account of their ^{Char.} beauty and mystery. To put it colloquially, they have all the makings of a game fish, but their mode of life makes them difficult of access. In the north of Europe char, both the exclusively fresh-water species and a sea-going variety or species, rise freely to the fly, and run to weights of 3 lb. and 4 lb. But in our islands it is the exception to kill char with the artificial fly, even in lakes which are known to contain great shoals of them. A good basket of trout, says Mr. Watson, from Haweswater or Windermere, is pretty sure to contain a char or two; but although they come to the surface and feed greedily when the May-fly and bracken-clock are on, and again in autumn when winged ants are about, they spend most of the summer in the depths, hunting small crustaceans, as is supposed. Locally, when char take to surface-feeding, they are said to be "belbing."

The usual way of taking char with the rod in the English lake is with a couple of ash saplings about 12 feet long placed in the stern of a boat. To each line is attached a plumb of lead weighing $1\frac{1}{2}$ lb. or 2 lb., above which are attached four to six tail-lines carrying metal spinning-baits. No reel is used; the line, about 26 yards long, trails behind the boat as it is rowed over the deep water, and a bell on each rod gives warning when a fish has struck. Six to eight fish, averaging half a pound, are reckoned a fair day's take; a score of char is considered unusual fortune at the present time, but it is on record that, many years ago, one boat with two men took seventy-five in a single day. The annual charge for a licence for plumb-line fishing is 5s. Far the

greater proportion of char which find their way to the market are taken with nets. From immemorial times potted char has been reckoned a delicacy peculiar to the Lake District; but, in fact, there is not much superiority in the flavour of char over that of good and rather small trout. Such flavour as may be peculiar to them is pretty well disguised by the pepper and other condiments introduced as preservatives when the fish are potted. However, the industry is a fairly profitable one, the usual market price of char being 1s. 6d. a pound. The licence for a char-net in Windermere costs £1 13s. 4d., and the average take during the six years 1893-98 was about 4,000 lb., of the gross annual value of £250.

The Smelt (*Osmerus eperlanus*)

FINS.

First Dorsal: 11 rays.

Second Dorsal: Rayless, adipose.

Pectoral: 11 rays.

Ventral: 8 rays.

Anal: 15 or 16 rays.

TEETH.

Dentition strong; teeth on the upper jaw much smaller than those on the lower jaw or mandible; those on the vomer strong and fang-like, in a transverse series; conical teeth on palatine and pterygoid bones. Teeth on the forepart of the tongue very strong and fang-like, with several longitudinal rows of smaller teeth behind them.

The name "smelt" is popularly understood to refer to the peculiar odour emitted by this fish when caught; and to support this explanation the Rev. W. Houghton, in his *British Fresh-water Fishes*, cites the Greek adjective *ὀσμηρός*, fragrant, which Artedi (1705-1735) chose as the title of the genus. Professor Skeat, however, has pointed out that, although the fish in question bore the same name in Anglo-Saxon that we use at this day, the verb "to smell" has not been found in that language. He connects it rather with the verb "to smelt"—to fuse ore—the root meaning being "to melt." The Norwegian *smelta* and the Danish *smelt* signify both "a mass, a

lump," and "various kinds of small fish." The significance of the English name is, therefore, far from clear, but it may be assumed with tolerable certainty to be unconnected with the idea of odour, and the scientific name of the fish is only an erudite pun.

A remarkable fish, in more ways than one, is the smelt. In habits it is essentially estuarine, at least in Great Britain, frequenting only those rivers which enter the sea through long tidal channels winding amid alluvial flats. Towards the middle of March or beginning of April smelts ascend to the limit of high-water mark, and deposit their ova in immense quantities upon the gravel and stones just about where the water ceases to be brackish. After that they descend to the sea, but are believed not to go very far beyond the influence of fresh water, reappearing in the estuaries in August or September, and remaining there in shoals throughout the winter. Smelts are abundant in suitable places on the coasts both of Northern Europe and North America. Dr. Günther notes that in some districts, not in this country, this fish severs itself permanently from the sea, ascending rivers into lakes, and adopting an exclusively fresh-water habit. In doing so, it suffers in size, owing to less abundant crustacean food; fresh-water smelts being a much smaller race than their estuarine kin. The habit must be an ancient one, for smelts are found in lakes which have no communication with the sea.

In appearance the smelt is of delicate beauty; although the large mouth, strong teeth, and projecting lower jaw give the head rather a rapacious expression; which is, indeed, no misleading guide to character, for this fairy-like fish is actively predaceous, consuming enormous numbers of shrimps, eel-fry, and small creatures in general. The body is covered with scales of moderate size, sixty to sixty-two in a line from gill-cover to caudal fin. The lateral line disappears after the first eight or ten scales. The colour on the back varies from sea-green to palest brown; the sides are faintly tinged with yellow

or rose colour, with silvery reflections; but owing to the absence of pigment in the scales, the fish is semi-transparent, the bones and internal organs being visible through the skin. In size the smelt seldom or never exceeds eight inches in length. The flesh is exceedingly delicate, with a peculiar flavour unlike that of any other fish.

Little do townspeople understand of its excellence, for smelts are more perishable than most fish. To eat them in perfection one should rise betimes on a fair morning in October, and watch the nets being drawn ashore. To the distance of nearly one hundred yards the gentle breeze wafts the fragrance of the catch; fill your basket with the spoil, carry it straight to the kitchen, have them fried without cleaning, and sit down and enjoy such a breakfast as all the resources of the Mansion House could not furnish.

Formerly, smelts—or sparlings, as they are called in Scotland—were reckoned as white fish, fair booty for anybody who chose to net them. Science, however, having assigned to them their true place among migratory fish of the salmon kind, they come under the provisions of the Salmon-Fisheries Acts, and form part of the several salmon-fishings in the waters they frequent. But in consequence of no close-time being provided for them, they are netted during the spawning season, which has resulted in the ruin of a remunerative industry in some rivers, such as the Annan and the Nith. It is gratifying to observe that the Royal Commission on Salmon-Fisheries in their report just issued (August, 1902) recommend the establishment of a yearly close-time. In the Cree, one of the Solway rivers, the salmon-fishings passed in 1900 under the management of an angling association, the members of which were impressed by the destruction wrought by the small-meshed nets of the smelt-fishers among the smolts of salmon and sea-trout descending to the sea in April and May. Now this includes the period when the smelts ascend to spawn; gravid smelts and migrating smolts were hauled out indiscriminately, and tens of

thousands of the latter were destroyed for no purpose whatever, A close-time, accordingly, was instituted from April 1st to September 1st, with the entire concurrence of the fishermen, who find a difficulty in conveying these delicate fish to the market in warm weather. The result of this regulation has proved very satisfactory. In the seven months from September 1st, 1900, to March 31st, 1901, the four fishermen employed by the association took smelts to the value of upwards of £300.

Smelts formerly afforded very profitable fishing in the tidal waters of the Thames, but were driven away by the wholesale pollution which destroyed the nobler salmon. Now, however, that the current has been purified by the joint action of the London County Council and the Thames Conservancy, smelts once more ascend in large shoals as high as Teddington. There and at Richmond they have afforded sport in three or four successive years to juvenile anglers with a red worm ; nevertheless, smelts are scarcely entitled to rank as game fish.

CHAPTER XVIII

THE POWAN, THE POLLAN, THE VENDACE, AND THE GRAYLING

GENUS COREGONUS

THE genus *Coregonus* is a well-defined one, distinguished among others of the Salmon Family by the smallness of the mouth, the weakness of dentition, and the smallness of the ova. About forty species have been recognised, most of which are lake dwellers, although a few species descend to the sea like salmon. They are the white-fish, frost-fish, etc., of the North American lakes, where they provide very profitable fisheries; and they are found all over the arctic and temperate parts of Europe and Asia. Three species are found in the United Kingdom.

The Powan, or Gwyniad (*Coregonus clupeioides*)

FINS.	TEETH.
<i>First Dorsal</i> : 14 or 15 rays.	Few, minute, and deciduous; when persistent in adults, only on the tongue.
<i>Second Dorsal</i> : Rayless, adipose.	
<i>Anal</i> : 13 to 16 rays.	

The name "powan" is of Gaelic origin; it is but another form of that of pollan, a species of *Coregonus* from Ireland, and signifies a fish of the *pol*, lake or pool. Gwyniad is a Welsh word, equivalent to the title of white-fish bestowed upon this genus collectively in North America.

The powan is a gregarious fish, inhabiting very deep water, and abounds in Loch Lomond, in Ullswater and Haweswater, as well as in Bala Lake and a few other lakes in Wales. In the English Lake District it is called the Schelly (generally pronounced "Scheely"), a name also applied to chub in that district. This has led to some confusion in regard to the habits of this fish. Frank Buckland noted that it ascended the streams flowing into Ullswater; but, in fact, it is never found above the lake, although there are chub in some of the tributaries. In habits the powan closely resembles the char, except that it feeds on smaller and weaker organisms. Like the char, it leaves the deep water in autumn to spawn in shallow bays. In calm, warm summer weather it swims about the surface in shoals, taking small flies; and occasionally, but very seldom, it is taken on artificial trout-flies.

As I have never seen this fish I can only quote from those who have examined it, and they are far from agreeing in their description of the colour. Mr. Houghton wrote from a small specimen netted for him in Bala Lake, and describes the colour above the lateral line as "beautiful glossy brown, slightly tinged with delicate pink; iridescent and silvery below the lateral line; belly pure white; gill-cover bright silvery; eye large, with white irides." Professor Seeley, on the other hand, gives the colour of the back as "dark blue; the sides paler, often with a tinge of yellow; the belly and under-side silvery. All the fins are dull bluish-black, darkest at the margin."

Mr. John Watson, writing in 1898, says the powan, or gwyniad, has become rare in Ullswater, but is as numerous as ever in Haweswater. He records a single draught of gwyniad taken in the last-named lake some years ago which numbered fourteen hundred.

The flesh is said to be palatable, but it must be eaten quite fresh, being of a very perishable nature.

The Pollan (*Coregonus pollan*)

FINS.	TEETH.
<i>First Dorsal</i> : 13 or 14 rays.	As in the powan.
<i>Second Dorsal</i> : Rayless, adipose.	
<i>Anal</i> : 12 or 13 rays.	
<i>Ventral</i> : 12 rays.	
<i>Pectoral</i> : 15 or 16 rays.	
<i>Caudal</i> : 23 rays.	

The pollan is found only in the lakes of Ireland, and has been given distinct specific rank, although, from its close similarity in appearance, habits, and quality of flesh to the powan, or gwyniad, it requires close acquaintance with both fish to explain the difference between them. As I have never seen specimens of either, except in museums, I can only accept the conclusions to which skilled observers have come.

The only particulars about pollan which I can find are those given by Thompson in the *Proceedings of the Zoological Society* for 1835. He described the abundance of this species in Lough Neagh, and states that three or four draughts of the net at the mouth of Six-mile Water produced 17,223 pollan, which were sold for £23 6s. 8d.

The Vendace (*Coregonus vandesius*)

FINS.	TEETH.
<i>First Dorsal</i> : 11 rays.	As in the powan.
<i>Second Dorsal</i> : Rayless, adipose.	
<i>Anal</i> : 13 rays.	
<i>Ventral</i> : 11 rays.	

Pennant was no doubt correct when he interpreted the name "vendace" as representing the French *vaudoise*, or *vandoise*, a dace, for all the *Coregoni* are suggestive in appearance of the *Leucisci*. The French origin of the name has tended to strengthen the tradition, assuredly groundless, that

the vendace was introduced into Scotland from the Continent by Mary Queen of Scots. Rapidity was not a conspicuous feature of transport in the sixteenth century, and we have Sir William Jardine's assurance that the vendace is so delicate a fish, with such a slender hold upon life, that it will not endure a journey. Moreover, this species is unknown on the Continent of Europe, and is to be found only in a group of small lakes at Lochmaben, in Dumfriesshire, in Windermere, Derwentwater, Bassenthwaite Lake, and the river Greta.

In almost every respect the vendace resembles the other two British species of *Coregonus*. Its habits are similar, save that in Lochmaben there is no very deep water for it to retire to ; it is gregarious and herring-like in its movements, and spawns in autumn in the shallows. In appearance it is distinguished from its near kin by rather larger scales (sixty-eight to seventy-one along the lateral line, as against seventy-three to ninety in the powan), by the slight projection of the under-jaw, and by the possession of two fewer vertebræ than the powan (fifty-six instead of fifty-eight).

The vendace was of old held in high repute as a delicacy, and two local clubs were wont to hold an annual feast at Lochmaben for the discussion of the same. These have ceased to exist, and I am indebted to Mr. Service, of Maxwelltown, an experienced naturalist, for the following report upon the condition of what was once a somewhat famous institution :—

“The Vendace Club was still in existence in 1869, but was wound up in 1870 or 1871. No doubt the old minute books and other papers are still in the possession of Messrs. John Henderson and Sons (late Sir W. Brown and J. Henderson), Dumfries, but buried amongst the *débris* of this old legal firm, as their cellars are choke-full of papers. The St. Magdalene Vendace Club, an organisation of a very decided democratic kind, ceased shortly before the more aristocratic society. After fishing the lochs for vendace in the usual way, they held a meeting for Border games, etc.,

and some thirty-five to forty years ago this was rather a big annual event.

"As for the present status of the vendace, I hear from time to time of small takes by net (the Lochmaben magistrates, I believe, give the requisite permission) of a dozen or maybe two. It has always been a very unusual thing to take more than a very few dozens, big and wee fish, all told. I have no reason to believe that this most interesting species is less numerous, or perhaps I should say more scarce, than ever it was."

That vendace in Lochmaben should be few in number is no wonder; the marvel is that they should have maintained their existence in small shallow pools swarming with pike. They cannot be very numerous in the English Lake District, for Mr. John Watson, in all his long experience, has only seen half a dozen specimens in all. They never take fly or bait, and can only be caught in nets.

GENUS THYMALLUS

The genus *Thymallus* is very closely akin to that of *Coregonus*, and was treated as one therewith by Artedi and Lacepede; but modern ichthyologists have separated it, chiefly on account of the long, many-rayed dorsal fin. It consists of five species, whereof only one is British.

The Grayling (*Thymallus vulgaris*)

FINS.

First Dorsal: 20 to 23 rays.
Second Dorsal: Rayless, adipose.
Pectoral: 16 rays.
Ventral: 10 or 11 rays.
Anal: 13 to 16 rays.

TEETH.

Small teeth in the jaw bones, on the head of the vomer and the palatines. None on the tongue.

In the grayling we come back to the true game fish, for he is only second to the brown trout in the esteem of fair anglers. Nevertheless, it happens sometimes that this choice

fish is a source of exasperation to trout-fishers in southern English streams where trout are large and wary, and must be approached with as much nicety as a red stag. It is certainly provoking, when you have managed on a May morning to lodge a red quill delicately above a rising fish, and it floats down jauntily cocked, as natural as may be—it is provoking, I say, when the line tightens bravely, and you prepare to do battle with a lusty trout, to find that you are fast in a grayling. There were little to choose between the two fish, if both came in season at once; but the grayling departs from the habit common to most of the salmon kind by spawning with coarse fish in April and May. At that season it is tarnished in hue and slimy to the touch, a disagreeable object which nobody wants in his basket.

Far different is the appearance of the grayling after it has recovered from the exhaustion of reproduction, which, in the case of large fish, is not till the month of August. It is then a truly beautiful creature, with large scales giving the grey sides a delicate reticulation. The head is brown, the cheeks yellowish, and the under-parts silvery, but there is an indescribable purplish bloom all over the surface of the body, shot with golden reflections. The sides of the head and shoulders are firmly spotted with black; spots and bars also adorn the dorsal, sometimes the caudal, fin.

The flesh of the grayling is white, firm, and sweet, when in good condition. It is essentially a fish of clear water, being in that respect far more fastidious than the trout, which does not quarrel with a moderate amount of sewage pollution. I have never been able to detect the odour of thyme which the grayling has been supposed to emit when freshly caught, and to which it owes its title *Thymallus*. In this country I believe grayling are never found in lakes, but they grow to a larger size than those of Scandinavia. In English streams they commonly attain a weight of from 1 lb. to 3 lb., and occasionally are heard of over 4 lb.

The grayling is not gregarious like the *Coregoni* and smelts, to both of which genera it bears a family likeness ;

Distribution. but, like the trout, finds all company inferior to its own. Its geographical range corresponds pretty closely with that of the brown trout, but it is far less generally distributed, and it is not indigenous to the north of England, Scotland, or Ireland. However, within the last forty years or so it has been introduced to many waters where it was unknown, and has become thoroughly established and numerous in the Clyde and Tweed, the Eden, and elsewhere. The expediency of this has been sharply questioned by salmon and trout fishers ; and in truth it can scarcely be doubted that grayling, being at their period of greatest activity when salmon and trout are spawning, devour large quantities of the ova of these fish. Personally, I should be most strongly averse from bringing them into any salmon-river where they did not exist already, or to any stream where the trout are worth consideration. The chief, perhaps the only, superiority of grayling over trout from the sportsman's point of view is that they are in finest condition and rise most freely to the fly just at the season when trout are unfit to be taken. Let him, therefore, who hath two trout streams unconnected with each other, stock that which contains the less excellent trout with grayling ; so shall he have fine fare all the year through, and good fishing whenever water and weather agree. But the man of one trout stream will do best to leave well alone.

The artificial flies for grayling are of the same character as those for trout. To learn the refinement which has been applied to these of late years, and especially the supreme craft of presenting them "dry," there is abundant literature wherein

Indocti discant et ament meminisse periti.

In my opinion small grayling furnish a more toothsome repast than any trout except the choicest, and these also should be small.

CHAPTER XIX

THE SHADS, THE EELS, AND THE LAMPREYS

The Herring Family—The Allis Shad—The Twait Shad—The Eel Family—The Eel—The Grig, Glut, or Broad-nosed Eel—Sucker-mouthed Fishes—The Lampreys—The Lamprey—The Lampern—The Pride.

Twenty-second Family: CLUPEIDÆ: THE HERRING FAMILY

THE herrings are essentially fishes of the coast, none being found in the deep sea, and some of the species run into fresh water to deposit their spawn. It is an ancient race, fossil remains of genera nearly allied to existing ones being found in the chalk and more recent formations.

GENUS CLUPEA

In this genus the body is compressed laterally, and the abdomen is serrated. The scales are generally large or moderate in size. Two species enter British rivers to spawn.

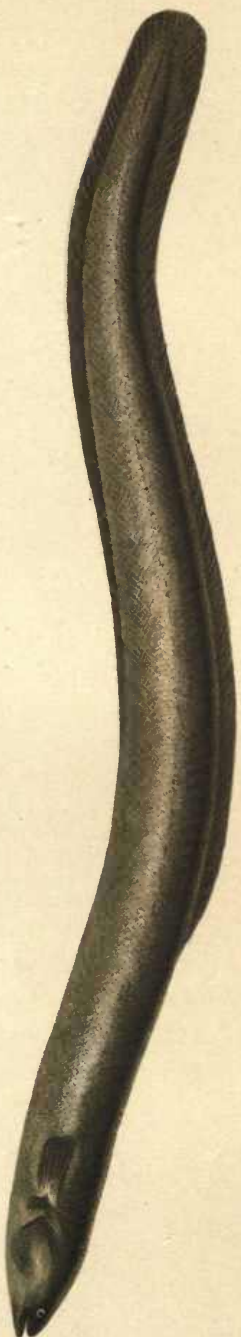
The Allis Shad (*Clupea alosa*)

FINS.
Dorsal: 19 to 21 rays.
Pectoral: 15 or 16 rays.
Ventral: 9 rays.
Anal: 20 to 24 rays.
Caudal: 19 rays.

TEETH.
Rudimentary or deciduous,
on the upper jaw only.

Etymologically the names "shad" and "skate" appear to be

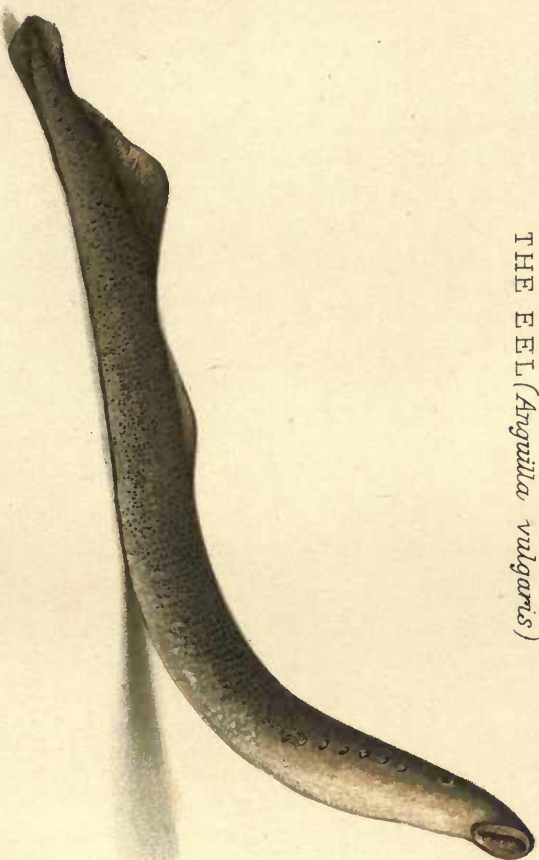
Photo by P. D. Malloch



$\frac{1}{2}$ Natural Size

THE EEL (*Anguilla vulgaris*)

Photo by Reinhold Thiele



$\frac{1}{4}$ Natural Size

THE LAMPERN (*Petromyzon fluviatilis*)

of common origin. Scarcely could two fish be more different in appearance, but if there is anything more slippery than fish themselves, it is the nomenclature by which men have distinguished them at different times. Anyhow, the shad was known in Anglo-Saxon as *sceadda*, which appears to be the same word as the Gaelic *sgadan* and the Welsh *ysgadan*, herring, and the shad is but a larger herring.

The shad is remarkable as being the only British fish of fresh water that possesses eyelids. These are merely folds of transparent skin, opening with a vertical slit, instead of a horizontal one, as in birds and mammals. The body is covered with large silvery scales; there is a conspicuous and large dark blotch on the shoulder just behind the operculum, or upper gill-cover; sometimes followed by two or three other such spots in a horizontal line. The abdomen forms a sharp ventral edge from the anal fin forwards, armed with a row of from thirty-seven to forty-two spinous scales, like the teeth of a saw, supported by the sternal ribs. The most conspicuous of the fins is the caudal, which is deeply cleft, with sharply-pointed lobes. The middle rays of this fin are covered with a peculiar arrangement of long, pen-like scales, upon each of which are fixed three or four smaller scales. All of the Herring Family are distinguished by the ample development of the gills, the gill-opening being very large. In the Allis shad the gill-rakers (Fig. III. 62, p. 23) form a remarkable feature, being very long and fine, and numbering from sixty to eighty.

The shad is a well-known visitant to most of the large rivers of Western Europe and the Mediterranean. It is also found in the Danube, but in Russia its place is
 Distribution. supplied by a kindred species, the Black Sea herring (*Clupea pontica*). It used to be common in the Thames, and still frequents the Severn and the Wye. The principal shad-fishery is at Newnham, near Gloucester, where operations are begun towards the end of April or beginning of May, when

the regular inland migration begins. Nearly all the fish caught are disposed of locally, in the Forest of Dean, the flesh being described as similar, but inferior, to that of the herring. Shad occasionally ascend the Tay, the Tweed, and other rivers on the east coast, and when one of them gets into the herring-nets it is recognised as the "queen of the herrings."

Shad spawn in shallow parts of rivers in May and June, descending to the sea again in August. Navigation weirs

Habits. have interfered with its ascent of the Severn, and now it is never seen in that river higher than Worcester. It is not a sporting fish in any sense, although occasionally one may be taken by people "whiffing" for mackerel or pollack. In size the shad must be reckoned an important fish, most commonly weighing about 3 lb., but often attaining double that weight.

The Twait Shad (*Clupea finta*)

FINS.
As in the Allis shad.

TEETH.
As in the Allis shad.

There are no outward marks of distinction between the Twait shad and the Allis shad, save that the former is the smaller fish. Inasmuch as both kinds of shad frequent the same rivers at simultaneous seasons, and observe precisely the same habits, it might seem unnecessary to differentiate them as separate species; but there is one constant feature to prove that they are really different fish. In the Allis shad, as mentioned above, the outer branchial arch supports from sixty to eighty very fine and long gill-rakers—horny processes present in most Teleostean fish, which serve to protect the delicate organ within from contact with such floating substances as might be drawn in. The Twait shad, on the other hand, has but twenty-one to twenty-seven gill-rakers, which are stout and bony. Its flesh is said to

be inferior to that of the Allis shad, and full of bones, hence the French name for the fish—*la feinte*—which has been Latinised in its specific scientific name, *finta*, and which Littré explains to signify *que c'est une alose feinte*—"that it is a false Allis shad."

Thirty-first Family: MURÆNIDÆ: THE EEL FAMILY

The Eel Family presents certain strange modifications of vertebrate form, whereof some are so familiar as to have become the source of proverbial sayings. In this family ventral fins disappear, and the pyloric appendages, so numerous and various in many physostomous fish, have no existence. Scales are either absent or rudimentary.

GENUS ANGUILLA

This genus is characterised by having very small scales embedded in the skin ; by its excessively elongated and almost cylindrical form ; by the small teeth forming bands, and by the narrow gill-openings at the base of the pectoral fins. It contains twenty-five known species in the temperate and tropical zones, but none have been found in South America, in Western Africa, or on the western sea-board of North America. Two species are reckoned as natives of the United Kingdom.

The Eel (*Anguilla vulgaris*)

FINS.	TEETH.
<i>Pectoral</i> : 18 or 19 rays.	Small, in bands on both jaws and on the vomer.
<i>Ventral fins</i> absent.	
<i>Dorsal, caudal, and anal fin</i> united, containing, according to Benecke, 1,100 soft rays.	

The history of some of the commonest words is very interesting, exemplifying the similarity which the neutral process in unlettered, primitive man bears to that of the highly-

educated modern specialist. Thus, ages ago, in the remotest past to which we can trace language, Aryan man had associated the sound *agh* or *angh* with the idea of choking. The property of snakes which impressed him most was neither their poisonous fangs nor their prostrate attitude, but the power of the larger snakes to squeeze. Hence he came to speak of a snake as *aghi*, nasalised *anghi*, the choker, just as men of science have designated the largest known snake as *Boa constrictor*—the choker *par excellence*. Then small snakes required a diminutive term, which took the form of *aghla*, or *anghla*, appearing in Latin as *anguilla*, an eel, diminutive of *anguis*, a snake, and in Greek as ἔχis, a snake, ἔγχελυς, an eel. Whether the root word found its way into Germanic speech through Latin, or independently, is not very clear, but at all events there it is, in Anglo-Saxon, German, Icelandic, and so on. The eel is ineradicably the little snake; and just as men of every race entertain an instinctive horror for snakes, so there remain traces of the same feeling about eels. It is true that most civilised races have overcome this long ago, and eels are so well thought of as food in this country that we import very large supplies from Holland. Yet, although there is no more intelligent and practical peasantry in the world than the Scots, there exists among them a strong and universal prejudice against eels. The waters of Scotland abound in eels, but you will find never a Scot who does not treat with shuddering or contempt the idea of eating one. I myself, though I have eaten eels (without much relish), must confess to a feeling of dislike to the creature. Its stealthy, gliding motion in the water, its powerful contortions in the hand and its extraordinary tenacity of life, are associated with the idea of something “uncanny” and malign. However, this is all nonsense, of course; the eel is excellent, nutritious food, whereof the supply is in no danger of running short in the British Isles. On the contrary, the resources of our waters in the matter of eels is well-nigh inexhaustible, and it is to be

regretted that they are not more generally developed, and that our own people do not exert themselves to secure some of the profit which Dutchmen derive from supplying the English market.

To describe the outward appearance of the eel to English readers would be superfluous, but some of the leading characteristics may be noticed. In the first place the eel has scales, which are generally overlooked, because not only are they very small and transparent, but they are embedded in the skin, which, again, is so profusely anointed with slime as to render superficial observation deceptive. This may serve to distinguish the fresh-water eel from the conger, which has no scales. The eye is small and covered with transparent skin, and the dorsal, caudal, and anal fins are united in a continuous band, forming a broad spear-shaped point at the tip of the tail.

The gills are a beautiful piece of mechanism. The eel is a fish, and the proper place for a fish is in the water, no doubt, which is necessary to keep its gills—that is, the equivalent of its lungs—in working order. But the business of an eel sometimes obliges him to take short cuts across country (it is not necessary to salvation to believe that they come by night, as some have affirmed, to steal newly-sown pease !), and to fit him for such journeys he has an apparatus enabling him to carry water with him. The gill-openings of the eel are small slits, close to the pectoral fins. These slits are protected by a fine membrane stretched on slender bones after the manner of the frame of an umbrella, and within each slit there is a large cavity, at the back of which are the gills. The eel has the power of retaining in the gill-cavity enough water to keep the delicate folds or branchial laminæ afloat, and so long as this can be done, the fish will not die of suffocation. That is part of the secret of the extraordinary tenacity of life possessed by eels. When one is taken from the water these gill-cavities, so important to his well-being, appear as a conspicuous swelling on each side of the throat.

In colour the common eel varies considerably according to season and nature of habitat. Sex, also, probably affects the skin tints, but that is still very uncertain, by reason that the organs of reproduction are so exceedingly small while the fish remains in fresh water, that it is only by aid of the microscope that male and female can be distinguished. The back of the fish is dark olive-green, sometimes tending to brown. Below the lateral line the tints become either golden or silvery, and the under-parts are white. In one respect the eel is almost unique among fishes: it always seems to be in good order, firm and plump—if plumpness is a term applicable to a creature measuring fourteen or fifteen times as much in length as in depth.

The northern limit of the eel in Europe has been fixed by Dr. Günther at 64° 30' North latitude. It exists all round the Mediterranean, but, strange to say, is not found
Distribution. in the Black and Caspian Seas. On the American coast of the Atlantic it meets with other species, but does not extend to the Pacific watershed. In Britain it may be said to exist everywhere.

The life-history of eels has been an attractive mystery to man ever since he began to indulge curiosity about the ways of his humble fellow-creatures, yet it is only within
Habits. the last quarter of a century that any certain light has been thrown upon their domestic arrangements. Aristotle, baffled in trying to solve the enigma of their reproduction, had recourse to the unphilosophic theory of spontaneous generation, the outcome of putrefaction. Gesner (1516-1565) could suggest nothing better, and even at this day there are people in this country who believe that eels may be produced by steeping horsehair (the hair of a stallion for choice) in water. Yet one can scarcely afford to smile at such simplicity, seeing that, down to 1896, scientific ichthyologists classed eels in the larval stage as a distinct order, or at least a distinct family, of fishes under the title of *Leptocephalidæ*. It is

true that Dr. Günther refused them a separate place in his system, but his reason for doing so is evidence of the darkness which prevailed as to the true character of these creatures.

"We must come to the conclusion," said he, "that the Leptocephalids are the offspring of various kinds of marine fishes, representing not a normal stage of development (larvæ), but an arrest of development at a very early period of their life. They continue to grow to a certain size without corresponding development of their internal organs, and perish without having attained the characters of the perfect animal."*

It was reserved for the Italian naturalist Grassi to demonstrate beyond all manner of doubt in 1896 that *Leptocephalus* was the larval form of the eel, produced from eggs laid in the sea, probably pelagic, or free-floating.

In its next stage of growth most dwellers near the sea are well acquainted with the eel. It is in May and June that the remarkable phenomenon of "eel-fare" takes place, when the young eels, known as elvers, "fare" up from the sea in countless myriads. They are slender, semi-transparent creatures, two or three inches long, about the thickness of a small crowquill, and appear in such prodigious numbers that I have seen a Scottish trout-stream slate-coloured from bank to bank with the throng for a distance of twenty or thirty yards. It is a display of the prodigality of Nature, as well as of her heartlessness to the individual fate of her creatures; for it must be only a very small percentage of elvers which escape the voracity of birds and fish at this tender age. Even man deigns to consider elvers a delicacy. Couch, the ichthyologist, was told by a Cornish fisherman that he had seen at Exeter four carts loaded with elvers for sale. They are fried in a form called elver-cakes, presenting, says Mr. Montagu, "a peculiar appearance from the number of little black eyes that bespangle them."

Now, albeit the connection between *Leptocephali* and elvers

* *Introduction to the Study of Fishes*, p. 181.

has been well established, we are far from being complete masters of the eel mystery. The elvers ascend the streams all round our coasts, penetrating to the remotest lakes and the most secluded pools, frequenting the channels of the greatest rivers as well as the wayside ditch. Wherever a living is to be made under water, there you may reckon upon good store of eels, but of their rate of growth nothing is known. Neither has it been ascertained how long they remain in fresh water ; only this is certain, that a time comes when an exodus takes place seaward. Not a migration of the whole eel population, as is the case with salmon and smelts; only of those individuals which begin to feel the sexual impulse. In the autumn months these begin dropping down the rivers, when they are taken in large numbers by "eel-bucks"—wicker baskets fashioned inside like a mouse-trap and set in a wooden framework across the stream.

The question has often been discussed whether eels ever return to the river after spawning in the sea. Probably they do not, for there is no trustworthy evidence to that effect, and the acumen of fishermen may generally be trusted to detect the seasonal movements of their game. It seems most likely that eels remain in fresh water for an indefinite number of seasons, till the generative impulse makes itself felt, when they at once go to the sea. There the development of the organs of reproduction is very rapid, and the exhaustion after the act of reproduction so great that both sexes die, having fulfilled the primary law—*increase and multiply*. The number of eggs in the ovary of a female eel thirty-two inches long has been computed at ten millions seven hundred thousand.

In the complete absence of all evidence to the contrary, it may be assumed that it is only in salt water that eels can spawn. This seemed to be hard to reconcile with the fact that throughout the long period, sixty or seventy years, when the Thames was closed by pollution to fish from the sea, eels continued abundant in that river above the tideway. So

foul was the river that Dutch fishermen had to give up bringing live eels in the wells of their boats for the London market, because they were poisoned so soon as they entered the Thames. How, then, did the eels in the middle and upper reaches continue to exist after the annual eel-fare ceased? The solution is found through the Thames and Severn canal. The eels now in the Thames were bred off the west coast of England, ascended the Severn in the usual manner, and thence found their way into well-plenished quarters in the eastward-flowing river.

Judging from what has been recorded in the *Jardin des Plantes* of Paris, the life of an eel may be prolonged to a great number of years. Desmarest kept one there for thirty-seven seasons. For the first fifteen years, 1838 to 1853, it lay in an earthen pan, where it could not extend itself, but lay coiled up. It was regularly fed on beef in summer, but refused all food in the winter months. After 1853 it was treated to a larger tank in summer, but returned to its pan in winter. Its fate after 1875 has not been made known to me.

On one occasion this eel was frozen in its pan, but revived after thawing with tepid water. There are numerous stories of eels recovering from being hard frozen. One such was told me by a Highland keeper, which I repeat without comment, except to say that I have no special reason to suspect that he was lying. One frosty morning early (I forget in what month) he was crossing a glade in a wood on the banks of the Teith at Blairdrummond. He showed me the place, and described the ground as being white with a heavy hoar. Noticing a quantity of straight sticks lying about, he picked up one, and was amazed to find that it was an eel, frozen stiff. He collected as many as he could carry conveniently, took them home, flung them in a corner of his kitchen, and sat down to breakfast. By the time he had finished his meal the floor was covered with wriggling eels!

The destruction wrought by eels upon other fish is

enormous. If the pike should be hunted down as a common pirate, the eel deserves to be dealt with as a midnight assassin. The pike, at all events, is not known to devour the spawn of other fish, but eels work sad havoc on the "redds" of salmon and trout. The pike, also, may be taken with rod and line after showing fair sport, but nobody cares to angle for eels save for the pot. "The Ele," quoth Dame Juliana Berners, "is a quaysy Fysshe. A ravenour and devourer of the brode of Fysshe, and the Pike also is a devourer of Fysshe. I put them bothe behinde al other for to angle." The mess which an eel will make with tackle intended for other fish is indescribable. Once, and once only, did I catch an eel when fly-fishing for trout. It was where a burn ran shallow over a shingly beach into the sea, a part of the current where I had learned to look for common trout grown uncommonly fat on tidal fare. My gut cast was of the finest; a Chinese puzzle was a joke to it after the eel, an insignificant creature about nine inches long, had dealt with it for the space of five or ten seconds. The fly was a small red spinner when it started.

Luckily for anglers, the common eel does not attain the huge size which some of the family reach—the conger, for instance. An eel of 3 lb. is a large one, but they are taken sometimes considerably heavier than that. Frank Buckland gave the dimensions of the largest eel he ever examined and cast. It was taken in the river Mole, measured 4 feet 4 inches in length, 10 inches in girth, and weighed just under 10 lb.

The Grig, Glut, or Broad-nosed Eel (*Anguilla latirostris*)

FINS.

As in the common eel, save that the distance between the commencement of the dorsal and anal fins is shorter than the head.

TEETH.

Those of the lower jaw are in a single band, without longitudinal groove. Otherwise, as in the common eel.

There has been considerable difference of opinion among

naturalists as to the specific rank of the grig, or broad-nosed eel—an animal of precisely similar habits, so far as they are known, and of very similar appearance to the common eel. It has a broader head and blunter nose than the other ; but the feature which seemed to Dr. Günther to justify its recognition as a separate species is the dorsal fin, which “begins further backwards, the distance between the commencement of the dorsal and anal fins being shorter than the head.” It has a very wide range, being described in the *British Museum Catalogue* as inhabiting European waters generally, the Nile, China, New Zealand, and the West Indies.

Third Sub-class : **CYCLOSTOMATA: SUCKER-MOUTHED FISHES**

The British list of fresh-water fishes is brought to a close by two species of the peculiar and archaic type *Cyclostomata*, creatures whereof the skeleton is entirely cartilaginous. The vertebral column is represented only by the notochord, or undivided dorsal chord ; there are no ribs, no limbs, no scales, and no real jaws, the mouth being suctorial, surrounded by a circular or nearly circular lip. There is but one nostril ; the reproductive organs are single, consisting of but one ovary or milt in each fish ; and on each side are seven branchial openings to the gills.

First Family : **PETROMYZONTIDÆ: THE LAMPREYS**

But for the presence of two rayed dorsal fins and a small rounded caudal fin, the lampreys, both in appearance and parasitical habits, are far more suggestive of large worms than fishes. The skin is naked, and the body shaped like that of an eel or worm. The mouth is suctorial, circular when open, and forms, when closed, a longitudinal furrow ; not transverse,

as in the sturgeon. It is armed with horny teeth, which, in spite of the circular form and boneless character of the orifice, can be distinguished as maxillary, mandibular, lingual, and suctorial. The eyes, which are only rudimentary in the larval stage of the animal, are developed in maturity, but they are very small. They are placed one on each side of the head, close in front of the seven gill-openings, with which they have the appearance of forming one series. The single nostril is in the middle of the upper side of the head, and ends in a blind sac, without perforating the palate.

The Lamprey (*Petromyzon marinus*)

The name "lamprey" comes to us through the Old French *lamproie*, a contracted form of the Low Latin *lampreda*, which is a transposition of the older form *lampetra*, the lick of rocks or stone-sucker. The peculiar habit of the fish in adhering by its mouth to stones, and even lifting them, is the obvious source of the name, and the Greek equivalent, *Petromyzon*, has been assigned as the scientific title of the genus.

The length of the lamprey is about fifteen times greater than its utmost depth. The skin is very slimy, and usually coloured grey or yellowish-grey on the back and sides, abundantly spotted or marbled with dark brown or black. There are two dorsal fins, whereof the second is confluent with the caudal fin. The eyes are very small, situated just in front of the seven circular gill-openings. The single nostril is on the top of the head, between the eyes, and is encircled by white spots. The most remarkable feature is the mouth, which, when open, forms a disc, without any indication of division into jaws, round which the teeth are arranged in rows, large in front and small behind. In the middle of the disc, at the back of the throat, is a plate armed with seven or eight strong teeth, and the tongue also carries three teeth. Outside

the teeth, the circular lip is fringed on the inside with a row of short and slender tentacles.

It may be asked, What is the purpose of this formidable armature without jaws to work it? The use to which it is put has been well described by Couch :—

“For simply biting, as in other fishes, the teeth are useless ; but when the breadth of the open mouth is brought into contact with the surface of a fish on which the lamprey has laid hold by producing a vacuum, these roughly-pointed teeth are brought forward in a manner to be able to act on it by a circular motion, and a limited space on the skin of the captive prey is thus rasped into a pulp and swallowed, so that a hole is made which may perhaps penetrate to the bones, from the torture of which the utmost energy of the victim cannot deliver it.”

He mentions that he has found lampreys thus feeding upon the living bodies of mackerel, gurnard, coal-fish, cod, and haddock ; and Günther mentions that salmon have been taken far up the Rhine with these formidable creatures fixed to them and boring into their flesh.

Lampreys ascend the rivers from the sea in spring in order to deposit their spawn. It is stated that at this season a fimbriated crest rises on the back, probably only of the male, between the head and the first dorsal fin, and a corresponding adornment appears on the under part of the tail, behind the vent. Such a feature has its analogy in the nuptial livery of some of the aquatic reptiles with which some naturalists have been inclined to associate lampreys more closely than with fish. After spawning, lampreys exhibit much exhaustion, and deteriorate in condition in as marked a degree as do salmon. It has been asserted that they all die immediately after spawning, but of this there is no satisfactory evidence forthcoming ; but it may be observed that eels are suspected of being capable only of a single effort at reproduction.

Lampreys attain a length of thirty inches and a weight of 3 lb. They were esteemed a high delicacy in old times, and are still to be seen in the shops of London fishmongers in spring, but it is to be presumed that they have lost their ancient repute, as I have never seen them served at table. It is probably one of the facts in history that stick most firmly in the memory of schoolboys, that Henry I. of England died after eating too freely of a dish of lampreys.

The distribution of this fish is a wide one, aided, perhaps, by its habit of attaching itself by the mouth to other fish and to the bottoms of ships and boats. It is found in most parts of Central and Southern Europe, except the Black Sea district, on the west coast of Africa north of the Equator, and on the Atlantic seaboard of America. In England the principal lamprey fishery is in the Severn.

The Lampern (*Petromyzon fluviatilis*)

The lampern bears a general resemblance to the lamprey, but in Britain does not often attain a greater length than fifteen inches, though it grows to the length of nearly two feet in Asiatic waters. It is not mottled like its larger relative, the back being of a uniform tint varying from steel-blue to olive-green; the sides are yellow, and the belly silvery-white. The fins, which are purplish, seem to be adipose, but really contain soft, branched rays. The eye is relatively larger than in the lamprey, with a golden iris, flecked with dark brown. The mouth is nearly circular, on the same general plan as the lamprey's, but less formidably armed. Within the cartilaginous lip is a fringe of short tentacles, surrounding a row of minute and easily-detached teeth. At the back of the throat is a large plate, armed with eight horny teeth. Two large teeth stand at the forepart of the mouth, and the maxillary plate carries only five very small teeth. There are two teeth on the tongue.

The seven gill-openings are ranged in a line behind the eye, and between the eyes is the single nasal aperture.

The lampern is not known to descend to the sea. Its geographical range, however, is rather wider than that of the lamprey, for it is abundant in Russia and Japan, and extends as far north in America as Alaska.

Couch says that, although lampreys may be found in the rivers during every month of the year, individuals have been taken sometimes in the open sea, and some ichthyologists have maintained that the metamorphosis from the larval to the adult form takes place in the sea. Little, however, seems to be known about the migration of these fish. They spawn in swift-flowing shallows in March and April, at which season their skin shines with a metallic lustre.

Lamperns have never been so highly esteemed for the table as lampreys, albeit Buckland declared that "there is no finer dish," and that when he was fishery inspector the people of Worcester used often to complain to him that they could not get lamperns to stew, because, although multitudes were caught in the Severn, they were all packed off wholesale to be used as bait for cod by the North Sea fishermen. In his Salmon-Fishery Report for 1878 he describes large quantities as being taken in the Trent—as many as 3,000 at Newark in one night—all of which were sent alive in wicker baskets to Great Grimsby and other eastern ports for bait. The fishing begins in August and continues till March, and it has been stated before a Royal Commission that a single fisherman has taken as many as 120,000 in a season, and that another fisherman received £400 for his catch in a like period. In the Thames, which used to furnish an enormous number of lamperns, the fishing was reported about 1872 to have dwindled to insignificance.

The lampern has not been detected in preying upon the bodies of living fish after the manner of the lamprey, and probably contents itself with smaller animal organisms.

The Pride (*Petromyzon branchialis*)

The larval form of the pride, or mud-lamprey, was for long classed as a separate genus under the name of *Ammocætes*. The adult fish very closely resembles the lampern in appearance, but it does not reach the same size, seldom exceeding eight inches in length, with the thickness of a swanquill, and the mouth is not so circular as that of the lampern. The general coloration is yellow, dark on the back and lighter on the sides. The lip tentacles are longer than in the other species, but the outer series of teeth is absent or rudimentary. In the arrangement of the other teeth the two species are nearly similar. In distribution it is co-extensive with the lamprey and lampern, but, unlike those species, it extends into the region of the Black and Caspian Seas. When sought after by fishermen, it is as bait for sea-fish. The humblest in the scale of British fresh-water fishes, the pride also approaches most nearly in habits to the annelids, or worms, from which, on a superficial observation, it is scarcely to be distinguished. It shuns the clear, gravelly shallows beloved by lamperns, and seeks out sluggish backwaters and pools, where it buries itself in mud, and derives sustenance from such animal substances as it can find there. It is believed to remain in the larval stage for three or four seasons, during which it is a toothless creature, sometimes as much as seven inches long, with a peculiarly small head and a transparent abdomen.

APPENDIX

RECENT RESEARCH ON THE SALMON DISEASE

SINCE the observations upon the salmon disease (pp. 210-212) were printed, Mr. J. Hume Patterson, Assistant Bacteriologist to the Corporation of Glasgow, has published an account of the important discovery he has made in the course of his researches into the nature of the disease.* His report contains a detailed description of the experiments whereby he has established the fact that the fungoid growth known as *Saprolegnia ferax* does not constitute in itself, as Professor Huxley supposed, the active agent in the disease. *Saprolegnia* is simply a mould or fungus, which finds its appropriate soil in dead animal matter, and is no more capable of growing upon living flesh of fish than it is upon the surface of a flint.

But Mr. Patterson has discovered a micro-organism which does establish itself in the bodies of living fish, especially those of the salmon kind. Apparently this micro-organism can only invade the body of the fish where the superficial tissues have been wounded; in other words, where the skin has been injured or broken. Having obtained entrance in this way, it multiplies with great rapidity, forming areas of necrosed or dead muscle, which offer a suitable nidus for the *Saprolegnia*. Mr. Patterson has named this new micro-organism *Bacillus*

* *The Cause of the Salmon Disease: A Bacteriological Investigation.* By J. Hume Patterson. Presented to Parliament by command of His Majesty. Price 1s. 2d.

salmonis pestis. The scrupulous care with which he has proceeded from stage to stage in his investigations, and the patience with which he has checked them by experiments, preclude all reasonable doubt that a great advance has been effected in our knowledge of the pathogenic cause of the disease, which must form the basis of all future endeavour to mitigate the evil. At present, no suggestion of preventive or remedial measures can be put forward, beyond that contained in No. 5 of the conclusions contained in Mr. Patterson's report. It will be observed that nothing in this important discovery lends the slightest support to the popular and mischievous delusion that the salmon disease arises from too large a stock of fish.

MR. PATTERSON'S CONCLUSIONS

(1) "The fungus *Saprolegnia ferax* is not the cause of the salmon disease.

(2) "The disease is due to the invasion of the tissues of the fish by a special bacillus (*Bacillus salmonis pestis*).

(3) "The bacillus gains access through abrasion or ulceration of the skin, and the disease is apparently not contracted when the skin of the fish is in a healthy state.

(4) "*Bacillus salmonis pestis* can be transmitted from dead diseased fish to other dead fish in the same water.

(5) "*Bacillus salmonis pestis* can be transmitted from dead fish to living fish in the same water; and since dead fish are a suitable nidus for the growth of the bacillus, it is obviously desirable to have all dead fish removed from the river, immediately they are observed, and *burned*; because, by simply burying, the germ is left in a condition to be carried again into the stream.

(6) "The fact that the bacillus grows profusely when placed in a freezing mixture of salt and ice, while a temperature of

37° C. (100° Fahr.) soon destroys it, shows that the cold season is more favourable to its growth.

(7) "Fish akin to salmon are more susceptible of the disease than others, as rainbow-trout, river-trout, and sea-trout when attacked succumbed in from two to four days, while dace and gold-fish died in about eighteen and thirty-five days respectively.

(8) "*Bacillus salmonis pestis* grows well in sea water, whereas *Saprolegnia* does not grow at all ; therefore a diseased salmon entering the sea, and returning to the river apparently free from fungus, cannot be said to be free from the disease."

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